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IN THIS ISSUE

THE application of medical and objective technique has contributed significantly to the progress of medical sciences. One of the more recently developed of such techniques is the electrostethograph, by means of which the sounds emanating from the human heart may be recorded graphically and permanently in the form of a tracing on a photographic film. In the belief that the instrument offers a new method for studying cardiovascular mechanics, the United States Public Health Service has undertaken a broad program of research. In "Cardiometric Studies on Children," Drs. Bert R. Boone and Antonio Ciocco present the preliminary results of a qualitative examination of stethographic records obtained in a survey of nearly 1,500 school children. The various patterns of heart sound tracings are described, age and sex differences are discussed, and other general data are given as background material for future studies.

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In some southern states, pellagra stands about fifteenth as a cause of death, exceeding the number of deaths from such diseases as typhoid fever, diphtheria, measles, and poliomyelitis. But, while pellagra is by far the most serious of the deficiency disease problems of the South, there is ample evidence of the existence of other deficiency diseases also, such as scurvy, beriberi, nutritional edema, and nutritional anemia. In the article, "The Nature of Nutritional Diseases Occurring in the South," Dr. W. H. Sebrell discusses reasons why therapeutic measures should be supplemented by programs for the prevention of these diseases. The steps he advocates are the initiation of intensive educational efforts to improve the dietary standards of low-income groups in the areas where deficiency diseases are prevalent, and, through crop diversification, the increase of the local supply of natural preventive foods.

Past studies of differences in fertility according to socio-economic status, with a few exceptions, have been confined to married women. Such restriction serves to hold constant variations in proportions married and yields indications of trends of the variations in the fertility of married women. It is also important, however, to know the present status of class variations in fertility when the influence of differential marriage frequencies is taken into account. Furthermore, there is increasing desire to learn more about potential rates of growth among populations classified along socio-economic lines, and the level of reproduction rates depends upon proportions married at different ages as well upon marital fertility. It is mainly due to lack of suitable data that the above questions have been so largely neglected. In view of this dearth in the literature, Bernard D. Karpinos of the United States Public Health Service, and Clyde V. Kiser of the Fund's staff, present in this issue a paper, "The Differential Fertility and Potential Rates of Growth of Various Income and Educational Classes of Urban Populations in the United States." The basic data were collected in the National Health Survey, conducted by the United States Public Health Service, and embrace nearly 600,000 urban white females 15-44 years of age, enumerated in 83 cities of 19 states. The data afford some indication of differential rates of reproduction among urban white groups and afford a comparison of the present status of class differences in fertility when the factor of variations in proportions married is allowed to operate and when it is held constant.

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"An Appraisal of Clinic Service," the third and last article in the series on the clinics of the Cincinnati Committee on Maternal Health entitled "Birth Control in a Midwestern City," by Regine K. Stix, discusses the need for changes in the accepted policies of birth control clinics. The method of contraception usually prescribed at the clinics is not suited to all types of patients and detailed study of the types of patients who reject it leads to the conclusion that clinics would do well to prescribe a number of different contraceptives, suiting each to the individual patient.

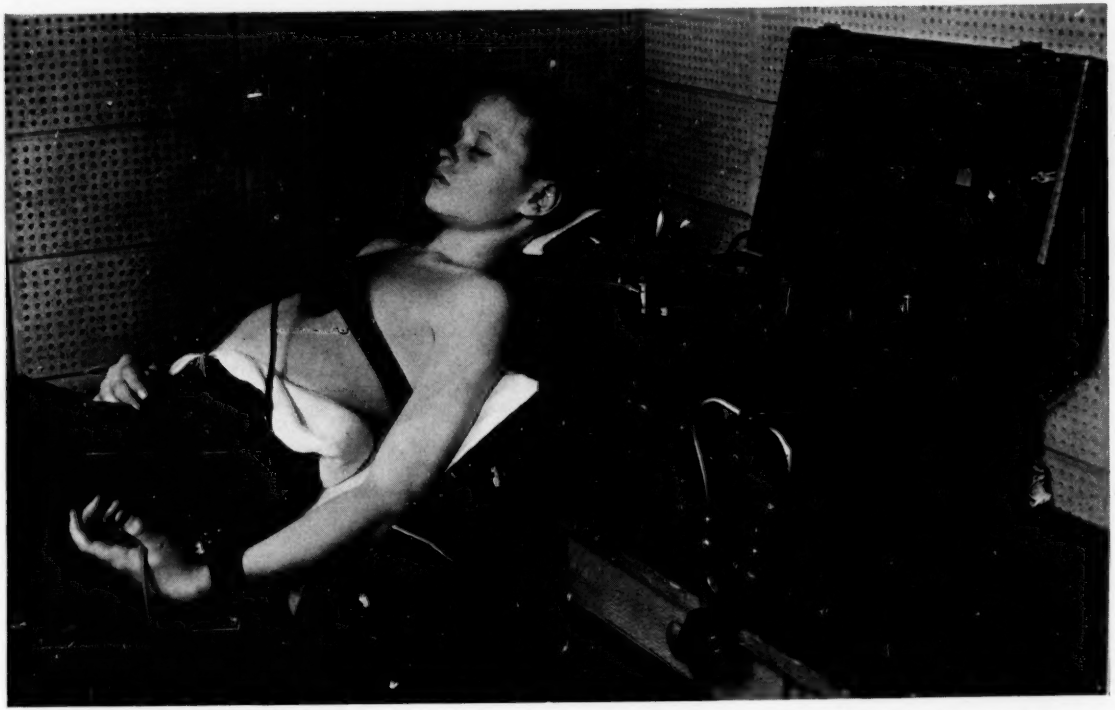

Fig. 1. Position of subject when given a stethographic examination. All the children examined were placed in this semi-reclining position. In this photograph the microphone is strapped to chest with the "bell" over the tricuspid area. The "pelotte" to record arterial pulsations is strapped over left radial artery.

CARDIOMETRIC STUDIES ON CHILDREN[1]

I. STETHOGRAPHIC PATTERNS OF HEART SOUNDS OBSERVED IN 1,482 CHILDREN

BERT R. BOONE AND ANTONIO CIOCCO

INTRODUCTION

IT IS a well-established fact that more deaths are attributed to a primary breakdown of the cardiovascular system than of any other single organ or organ-system. In 1930, for example, almost 23 per cent of the deaths among the white population of this country were listed as being due to diseases of the circulatory system and to congenital malformation of the heart. It has been repeatedly emphasized, and recently by Hedley (18), that although the bulk of this mortality occurs after middle-age, *all* ages are substantially affected. This is well illustrated by the fact that in 1930, in the white population, a cardiovascular disease was stated to be the principal cause of death of 6 per cent of the infants who died, 5 per cent of the children who died between one and 14 years of age, 12 per cent of the dead persons of age 15 to 49 years, and of 31 per cent of the dead aged 50 years and over. Thus, the official vital statistics show clearly that throughout the whole life span cardiovascular diseases are the primary cause of a considerable proportion of the deaths. This is so because the factors that bring about the breakdown of the heart and vascular system are several and they exert their lethal activities at different periods throughout the span of life.

From the data collected and presented by many investigators [*cf.* Wyckoff and Lingg (44), DePorte (13), Hedley (19)], it is known that congenital defects cause the majority of deaths from heart disease in infancy; the rheumatic manifestations in childhood, adolescence, and early adulthood; while syphilis appears as an important factor somewhat later. However, these conditions produce

[1] Child Hygiene Studies, Division of Public Health Methods, National Institute of Health, United States Public Health Service.

directly only a limited number of fatalities that are attributed primarily to cardiovascular diseases; by far the greatest number of cardiovascular deaths are associated with arteriosclerosis and other so-called degenerative processes that accompany advancing age. It is recognized that the age incidence of the latter forms of heart disease and their associated conditions is not the consequence only of the processes of ageing. Aschoff (1), in discussing the age incidence of arteriosclerosis, remarks (p. 5): "But mere ageing never results in deformation of the vascular wall and the vascular tube which are typical of arteriosclerosis. Therefore, arteriosclerosis is not merely a change or transformation attending the process of ageing; it is not a mere 'infirmity' of old age, but rather a disease of the vessels manifesting itself mainly during senescence." One can add that age *per se* is only a measure of the time interval during which the organism is exposed to the favorable and unfavorable conditions that influence its development and function. As the late T. Wingate Todd (36) wrote (p. 279): "Ageing implies therefore an unending alternation of injury and repair."

When such broad meaning is attached to the phenomenon of ageing it follows that the age incidence of the morbidity and mortality from cardiovascular diseases cannot be identical with the age at which the first injury to the heart and vascular system occurs. Instead, the former is the final expression of the age at which a deleterious agent first comes in contact with the organism, plus the time interval necessary for the agent to produce its injurious effects and, in addition, the length of time it takes the cardiovascular system to manifest its inability to cope with the damage received. Therefore, in the study of the genesis of heart disease these three temporal variables, dependent both on the inherent biological constitution of the cardiovascular system and on the environment, must be considered. Bearing on the validity of this viewpoint is the fact that heart disease resulting from rheumatic manifestations or syphilis may appear long after the rheumatic attack or the syphilitic

lesion. Relative to syphilis, the recent authoritative report by Cole *et al* (11) has shown that the clinical signs of cardiovascular involvement can develop as long as twenty years or more subsequent to the infection. With reference to rheumatic diseases, DeGraff and Lingg (12), investigating over 1,500 patients, brought out the important fact that while on the average eleven years elapsed between the onset of rheumatic manifestations and the first signs of cardiac insufficiency, about 20 per cent of their patients developed heart disease twenty years after the initial rheumatic attack and over 10 per cent after thirty or more years. If rheumatic fever and syphilis, each of which produces pathognomonic lesions and is definitely a causative agent of heart disease, take such a varied amount of time to give overt signs of their deleterious effects on the heart and circulatory system, it is possible that the action of whatever factor or factors responsible for the so-called degenerative forms of heart disease may also be manifest in a similar manner.

On the basis of this assumption one can regard the age characteristics of the morbidity and mortality from heart disease as the temporal expression of the resultant of interaction between the biological worth of the cardiovascular system and the cumulative effects of many factors. Some of these, such as syphilis and rheumatic fever and chorea, are well known but there are others that are not specific and therefore have not been definitely recognized. Among the last there is some reason to believe that nutritional deficiencies as well as acute febrile diseases should be included since they are probably more important with respect to heart disease than is generally realized. Weiss (38) and others have noted that lack of vitamin B_1 can impair the cardiac function, and that this impairment in turn can be corrected by dietary measures. Heart involvement is also often the immediate cause of death from acute febrile diseases, as is the case in pneumonia, for example [*cf* Stone (32)]. But to what extent these conditions in general predispose to later cardiovascular diseases is not known with any degree of certainty, although some

investigators think it is true of a number of the more common major infectious illnesses such as scarlet fever, diphtheria, and typhoid fever. Coburn (10) is of the opinion that scarlet fever is in some way related to rheumatic heart disease, while Nuzum and Elliott (25) report that a history of this disease is found often in hypertensive persons. In the opinion of Butler and Levine (7), diphtheria is a cause of heart block later in life, while Thayer (33), Barach (3), and Walker and O'Hare (37), from the data they examined, believe that typhoid fever is a causative factor in arteriosclerotic and hypertensive diseases. It is well to mention that none of the evidence presented regarding the relation of this group of diseases to cardiovascular failure later in life is conclusive. But when the possibility of such a relationship is borne in mind together with the other facts discussed above, it becomes apparent that to study adequately the genesis of heart disease the attention must be focused not only on the signs and symptoms that accompany it late in life but also especially on the means of discovering the first indications of its presence in the earlier years. Childhood and adolescence would seem to be particularly suited as a starting point of such an investigation for a number of reasons, including the prevalence of rheumatic fever as well as of the numerous exanthemata during this age period. Moreover, from the several surveys made in certain parts of this country it is seen that the incidence of heart disease among children varies from about 0.5 to almost 5 per cent, depending upon locality, age, and social characteristics of the sample studied [*cf.* the reviews of Sampson *et al* (30) and of Bainton (2)]. Sampson *et al* (30) report that in over 13,000 San Francisco school children the percentage of those found affected with all forms of heart disease equaled almost 0.4 per cent. In contrast, Paul *et al* (29), among 332 boys of a poor urban school of New Haven found 4.8 per cent with rheumatic heart disease alone. Thus, from these facts it is further perceived how valuable the period of childhood can be as a point of departure for a study of the genesis of heart disease.

All these considerations have led this office to initiate an investigation that has for its main objectives: (a) to study the characteristics of the cardiovascular activities in children and the factors associated with the related pathological and other changes observed during childhood and adolescence; (b) to formulate a public health program that will serve to facilitate and standardize surveys of the cardiovascular status of school children. To achieve either or both of these purposes requires, first of all, the development of methods of measuring as objectively as possible the cardiac function. Secondly, a more or less precise knowledge must be gained of the significance in terms of health and disease of the observations made. In view of these requirements, the initial step toward the planned objective will be in the direction of seeking and utilizing for the purpose the most adequate instruments that measure the activities of the heart and can be adapted as "screening" devices for the selection of those children with conditions that need intensive clinical study and special care.

Among the clinical instruments that give objective and permanent records of the status of the cardiovascular system, the two that measure more completely the principal cardiodynamic events are the electrocardiograph which records the changes in the electrical potentials of the heart, and the stethograph which registers the sounds resulting from the heart's mechanical activity. The electrocardiograph has long had a definite place in the clinic but has not yet been extensively utilized in the study of children not actually ill with heart disease. There are only a few studies, mainly those of Hecht (17), of Hafkesbring *et al* (16) and of Seham (31), that give data on the electrical characteristics of the cardiac activity of so-called normal children. The information collected by these investigators can in fact serve as standards for determining pathological variations. Use of this instrument in general surveys has been limited, however, probably because of the incidental cost and also because specialized knowledge is required for the interpretation of

the records. The second type of instrument, the stethograph, has been developed for practical use only in the last few years although the relation of heart sounds to healthy and diseased conditions of this organ has been definitely recognized for over a century, since Laënnec's invention of the stethoscope. Oriás (27), Braun-Menéndez (6), and others in South America, and McKee (24) in this country have studied the results obtained by the use of this type of instrument on "normal" persons and have pointed out the advantages that derive from it, not the least being that the records obtained can be described in terms corresponding to those used by clinicians when referring to the auscultatory findings on the heart.

In the investigation in progress particular emphasis is being placed on the study of the cardiac activity by means of both types of instruments so as to determine also the relative advantages and disadvantages that might be associated with the use of either as a "screening" device in surveys of school children. In this paper, however, the preliminary results obtained by the use of the stethograph alone will be discussed. This report, which is the first of a series, will describe some of the outstanding characteristics of the heart sound tracings as observed in a sample of 1,482 unselected school children of Hagerstown, Maryland.

The Stethograph

The limitations inherent in the direct and indirect methods of auscultation are becoming clearer and for some time students have directed their efforts towards developing methods of graphic registration of heart sounds. All the methods employed are based on the same general principle of substituting for the ear either a mechanical or an electrical device which by vibrating in resonance with the heart sounds records them graphically. The first satisfactory stethograph [*cf.* Oriás and Braun-Menéndez (26)] was that described by Einthoven and Geluk (14) in 1894. It utilized an electrical device and consisted of a carbon microphone to which was attached a capil-

lary electrometer. Of the mechanical type was the instrument introduced by O. Frank in 1904. Somewhat modified, this is the type of apparatus with which Wiggers, his associates, and students have contributed so extensively to our knowledge of the physiology of the heart and circulatory system.

Up until the last few years such instruments were designed primarily for laboratory research and only recently has it been possible to obtain stethographs that are precise, compact, portable, and relatively inexpensive. The apparatus used in this survey (the electrostethograph manufactured by the Cambridge Instrument Company) is based on the model described in 1935 by Bierring, Bone, and Lockhart (5). Their report contains the details of the technical and constructional characteristics of this instrument, which is here described only in its essential features.

This stethograph is composed of three basic units: the microphone, the amplifier, and the recorder. The microphone is formed by a piezo-electric crystal element fitted with an open bell. The amplifier contains vacuum tubes which increase the intensities of the sounds received. The recorder consists of a galvanometer, a moving bromide film, a ground glass visualizing screen, and a pair of stethophones. These units operate in the following way: The sounds from the heart reach the microphone and are converted into electrical impulses, these impulses are amplified to the desired levels by means of the vacuum tubes and actuate the recording galvanometer, deflecting a beam of light transversely to the movement of the bromide film. The viewing screen and stethophones make it possible both to observe and hear the sounds as they are recorded.

Through the use of this assembly of electrical and mechanical units, therefore, the sound vibrations from the functioning heart may be perceived in three ways: First, the sounds amplified in intensity may be heard if desired by applying the stethophone unit to the ears. Second, the sounds may be visualized as a moving beam of light upon the ground glass viewing screen. Third, a permanent

visual record of the sound waves may be perceived from the tracing made by the beam of light upon the photographic film.

In addition, this instrument is also equipped with a "pelotte" that can be placed over the radial, carotid, or any accessible artery. It consists of a glycerin capsule which transmits the impulses from the artery to a photographic recording unit within the stethograph. With the aid of the pelotte simultaneous arterial pulse tracings and heart sound records can be obtained.

Material

This report is based on the stethographic records obtained by examining the white children of two public schools of Hagerstown, Maryland. All the children in attendance in the schools on the examination days were taken, without exceptions. Obviously, however, children having serious heart disease or any other disease which prevented their attendance at the schools on those days are not included here. So far as health and disease are concerned, therefore, these records may be said to typify the ones that would be obtained in a routine school health examination.

Two schools, the Antietam Grade School and the South Potomac Junior High School, furnished the 1,482 subjects used. In Antietam School, 779 children were examined and they represent about 25 per cent of the elementary school population of Hagerstown, while the 703 children seen in South Potomac Junior High School represent about 45 per cent of the junior high school population of the City. The Antietam School is limited to the first six grades and draws its pupils largely from the poorer families, many of whom are supported by welfare agencies. On the other hand, the South Potomac School, which contains the seventh, eighth, and ninth grades, draws its students from families that represent fairly well the different socio-economic groups living in the City.

It can be said then that while this material is unselected with respect to heart disease it does not represent a cross-section of the

school population either from the standpoint of socio-economic status or from that of age. The last is evident from the following tabulation of the age and sex distributions of the children of this sample. Table 1 shows that 714 boys and 768 girls have been examined and that the mean ages are identical for the two sexes. It will also be noted that for each sex the age distribution is heavily weighted towards the higher ages. This illustrates well the fact that this sample contains a smaller proportion of young children than would be expected in a random sample of school children. This characteristic of the material must be kept in mind when evaluating the findings reported.

Table 1. Age and sex of Hagerstown school children who received a stethographic examination.

Age (in Years)	Number	
	Boys	Girls
6	40	50
7	53	49
8	44	58
9	47	54
10	60	55
11	71	59
12	99	122
13	128	129
14	101	132
15 and Over	71	60
Total	714	768
Mean Age	11.3	11.3

The Technique of the Examination

The elements of the examining procedure to which attention must be paid in the case of this test are three: the condition of the instrument, of the environment, and of the subject.

The working order of the stethograph was checked before and during each examination and in addition certain of the instrumental characteristics such as response to frequency of sound waves, the speed of film, and its uniformity were investigated at the United States Bureau of Standards before this work was begun. One of the most important of the instrumental characteristics is the speed and uniformity of movement of the bromide film on which the sound tracing is made. According to the specifications of the instrument,

the film moves at a uniform speed of 100 mm. per second. A verification of this fact was attempted by recording and measuring some known pure tones. For example, a tracing was made of a pure tone of a frequency of 100 cycles per second and the total distances occupied by successive series of cycles were measured under magnification with needle-pointed dividers. The results of this work indicated that it was impossible to detect, by the methods used, any significant variation in the speed of the film. At the end of the study the stethograph was again checked by the makers, who detected no alteration in the operating characteristics of the instrument.

Preliminary work with the stethograph brought out the fact that room noises interfere considerably with the satisfactory recording of heart sounds. In particular, it was observed that sufficient amplification of the cardiac sounds to produce good tracings resulted in the frequent appearance of extraneous sound waves. In some instances it was difficult to distinguish on the stethogram between a true cardiac and an interfering sound. The problem which arises from this situation was solved for the present study by making all of the stethograms in a specially constructed sound-insulated booth. This booth, having inside dimensions of 5 x 6 x 6 feet, is made of four thicknesses of one-inch celotex boards, and is so constructed that it can be moved readily from place to place in school or other buildings. The use of the sound-insulated booth, it is believed, has definitely improved the quality of the tracings obtained, and justifies the extra difficulties of working inside the booth.

All the tracings were made in the schools by a carefully trained technician and under the close supervision of one of the authors (B.R.B.). The children, three or four at a time, were excused from their classes and walked to the location of the booth where they were required to sit quietly for periods which ranged from ten to thirty minutes before their stethogram was taken. During this time they were carefully instructed regarding the "test" and assured that it would in no way cause discomfort.

Before entering the booth the boys disrobed to the waist; the girls removed their outer clothing so that they could disrobe to the waist quickly after entering the booth. Work by the technician in the booth was carefully systematized. The child was seated in a standardized semi-reclining position as shown in Figure 1. The microphone, fitted with the large open bell throughout, was placed on the precordium and secured there by a rubber strap encircling the chest. The pulse recording pelotte was adjusted over the radial artery of the left wrist. The adjustment of the pelotte presents no difficulties, and good excursion of the light beam was easily obtained.

The placement of the microphone on three successive areas of the precordium was made carefully as follows:

Mitral area: Approximately one inch below and one inch inside of the left nipple line. The intercostal space was used and not the rib surface.

Pulmonic area: The second intercostal space immediately to the left of the sternal border.

Aortic area: The second intercostal space immediately to the right of the sternal border.

Slight movement of the microphone around these areas was occasionally necessary in order to obtain the most intense sound and to seal properly the rim of the microphone against the skin.

After the proper adjustment at a particular area had been completed, the technician began to observe closely the respiratory rhythm of the child. As soon as breathing seemed to be regular, and always at a moment of expiration, the child was requested to stop breathing. It was during this period of cessation of respiration, usually made to last for the length of six to eight cardiac cycles, that the heart sounds were recorded.

The total time that each child remained in the booth was always less than ten minutes, and it is believed that fatigue was thus avoided.

Stethographic Patterns of Heart Sounds in Children

The heart sounds perceived on auscultation result from the propagation to the outer thoracic surface of the vibrations that emanate from the cardiac activity. Apparently a number of heart sounds can be perceived and, in fact, even without electrical amplification Parker (28) has been able to describe five which he says occur normally during the cardiac cycle. The two most easily recognized are the so-called first and second sounds, but in addition there is a third sound which Thayer (34) in 1909 found audible at the apex in 65 per cent of the persons examined, and a fourth sound presumably of auricular origin which Braun-Menéndez (6) discusses and credits Clendenning as having first mentioned in 1840. Parker's fifth sound is not well individualized although it is described as occurring between the first and second sounds of the cardiac cycle.

In general, however, the first and second heart sounds; their occurrence within the cardiac cycle; the changes in their duration, intensity, pitch, and quality have been particularly studied and are regarded of special importance for clinical diagnosis. This description of the stethographic characteristics of the cardiac cycle will therefore give particular attention to these two sounds.

The basic pattern of the cardiac cycle—composed of the first and second sounds—appears on the stethogram in the form illustrated and schematized in Figure 2. As is shown in this figure, on the stethogram the heart sounds are registered as waves, while the period of silence that occurs between sounds is represented by a section of smooth base line. A first series of waves corresponds to the first or systolic sound; it is followed by a segment of smooth base line, the systolic interval. This is terminated by a second series of waves that correspond to the second or diastolic sound which is followed by another period of silence recorded as a segment of smooth base line and termed here the diastolic interval. The first sound together with the systolic interval form the mechanical

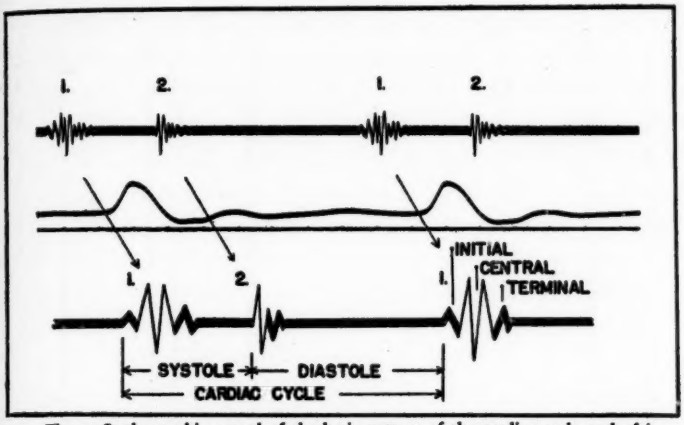

Fig. 2. Stethographic record of the basic pattern of the cardiac cycle and of its principal elements. Above is an actual tracing of two consecutive cycles. The first sound of each cycle is indicated by 1., the second sound by 2. This and all other tracings shown here have been recorded at a film speed of 100 mm. per second. The arterial pulse wave recording is also seen and serves to individualize each cycle. Below is a diagrammatic representation of the cardiac cycle to illustrate the basic stethographic pattern of the systole, the diastole, and the three groups of waves constituting the first sound.

systole; the second sound together with the diastolic interval constitute the mechanical diastole.

Schematically such is the stethographic record of the basic pattern of the cardiac cycle, the "lub-dub" of the textbooks. In this paper is given a report on the frequency with which the basic pattern occurs in the sample of children examined and on the number and characteristics of the variations observed. Particular reference is made to the variations that involve the rhythm of the cycle, the pattern of the first and second sounds, the intervals of silence between sounds, and the occurrence of other sounds.

I. RHYTHM

The frequency and regularity of the cardiac cycle within a given length of time can be measured accurately on the stethogram, since the sounds are recorded on a uniformly moving film. In a subsequent article, the biometric constants of the measurements of the

Fig. 3. *Above:* Actual stethographic record of a case of bigeminy or bigeminal rhythm found in one of the children examined. Note the coupling of the cardiac cycles and the long pause between pairs of cycles. *Below:* Actual stethographic record of a case of an occasional extrasystole. The "premature" cycle is shown by the brackets and the "compensatory" pause is also pointed out. In both tracings 1. indicates first sound and 2. indicates second sound.

rhythm and of other quantitative characteristics of the cardiac cycle will be presented, but in this preliminary report only those features of the periodicity of rhythm that are visible on inspection will be discussed.

It is well known that the rhythmic activity of the heart results from the periodic emission of impulses from the sinus node of Keith and Flack (21). The periodicity of impulses is not, however, absolutely uniform but varies perceptibly and continuously due to vagosympathetic [*cf.* Wiggers (41) (42)] and respiratory influences. As a result, the duration of the cardiac cycle—the length of time it takes for the heart to complete its cycle of activity—is not constant but varies from cycle to cycle. This variation in duration of cycle is almost always observed, so much so that some believe that perfect periodicity may be tantamount to a pathological condition. As a matter of fact, in this sample of children none was found that possessed perfect periodicity, or cycles of absolutely constant duration, throughout the period of examination. This is in agreement with the findings of McKee (24) in a sample of 105 children also examined with a stethograph. The extent of the individual variability relative to duration of cycle will be described in a forthcoming publication, and here it is sufficient to note that these findings support the accepted view regarding the rarity of a uniform rhythm of cardiac activity.

Besides the common irregularities or fluctuations of rhythm discussed above, variations in rhythm may have other more striking, and often clinically significant, characteristics. Of such major variations only two kinds were found in this sample: bigeminy and extrasystoles. Bigeminy is that condition in which two heart cycles are "coupled," i.e., follow each other closely, and each pair of cycles is separated from the following group of two cycles by a considerably lengthened diastolic interval (*cf.* Figure 3). This means then that in a group of two coupled cycles the diastole of the first cycle is shortened, whereas the diastole of the second cycle is lengthened. It is a

both tracings 1. indicates first sound and 2. indicates second sound.

rare condition about which no completely satisfactory physiological explanation has been advanced, although Wenckebach (39), especially, and Kaufmann and Rothberger (20) have formulated hypotheses not yet completely accepted. In this sample of children only one case of bigeminal rhythm was found and is illustrated in Figure 3. This finding is of interest because bigeminy is said to be found in persons with arteriosclerotic and degenerative forms of heart disease or, as Lewis (22) states, in cases of overdigitalization.

The occasional extrasystole is indicated on the stethogram (*cf.* Figure 3) by the occurrence of a cycle having a relatively abbreviated diastolic interval followed by a cycle in which the diastolic interval is of unusual length (compensatory pause). The systole of the second cycle is the extrasystole, the premature appearance of which has apparently shortened the diastole of the preceding cycle. The extrasystoles[2] are distinguished from bigeminal rhythm principally by their infrequent and irregular incidence in a succession of cardiac cycles. This variation of rhythm periodicity was here found in only five boys and four girls so that the relative frequency for the whole sample equals 0.6 per cent. That extrasystoles are found relatively infrequently in children is well recognized. McKee (24) does not mention any in her sample, while Lissnér *et al* (23) found only one case in 138 children examined with the electrocardiogram. Lewis (22), Hecht (17), Seham (31), Bass (4), and others have reported extrasystoles rarely in children and then only associated with diseases, although not always heart disease.

2. FIRST SOUND

Wiggers and Dean (40) appear to have been among the first to have shown that the waves which represent the stethographic registration of the first sound may be segregated into three distinct groups which they termed introductory, main, and final waves. Succeeding investigators have since adopted other terminologies and today

[2] It should be noted here that on the stethogram it is not possible to determine whether the point of origin of the extrasystole is auricular, junctional, or ventricular.

these three groups of waves are usually called, respectively, initial, central, and terminal. These three groups of waves are shown in Figures 2 and 4 in which the basic pattern of the first sound, i.e., the pattern corresponding to the so-called normal physiological status, is illustrated both schematically and with photographs of actual stethograms. They may be described in the following way:

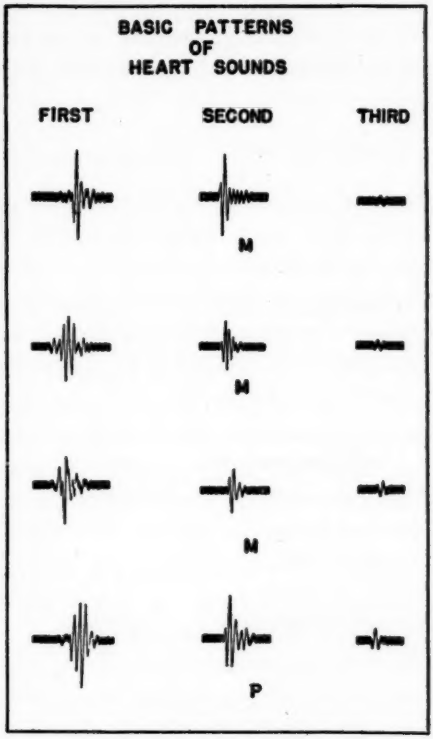

Fig. 4. Examples of the basic stethographic patterns of the first, second, and third heart sounds. M indicates that the record was taken with the microphone at the mitral area (apex) of the heart and P that it was taken at the pulmonic area (base).

(a) The low initial group of vibrations consists of ½ to 3 waves of low amplitude and low frequency. The amplitude may vary from a slight roughening of the base line to a height of several millimeters while the pitch is below that given by 50 double-vibrations per second.

(b) The central group of vibrations consists of from 1 to 5 waves of amplitude and frequency higher than those of the initial set. The amplitude ranges from 5 to 20 mm. in height of wave while the pitch is usually somewhat above 50 double-vibrations per second. It should be noted that occasionally the waves may appear notched or slurred (*cf.* Figure 4) but otherwise with no other modification in their continuity or character.

(c) The terminal vibrations consist of 1 to 3 low amplitude waves whose frequency appears to be essentially the same as that of the central group. The amplitude of these waves decreases rapidly as the end of the sound approaches.

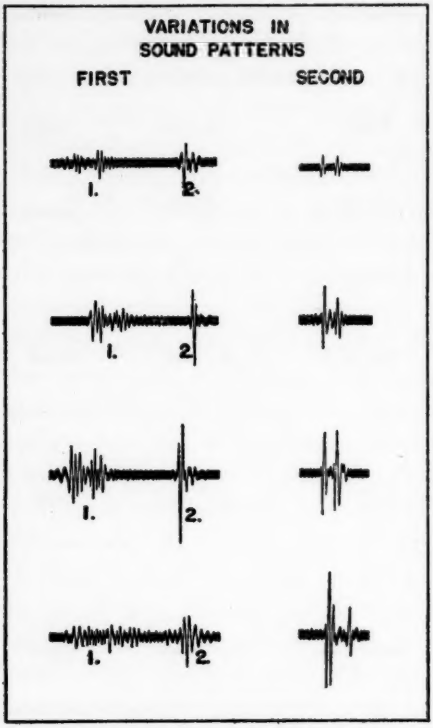

Fig. 5. Examples of variations found in the stethographic patterns of the first and second sounds. On the left, the three upper tracings of the first sound show various degrees of splitting together with prolongation. The bottom sample exhibits marked prolongation of the first sound and no definite termination. On the right, the records of the second sound exhibit various degrees of splitting and both components of the sound have nearly equal amplitude.

The basic pattern of the first sound characterizes almost 98 per cent of the stethograms of the children examined. Variations from this pattern were found in 3.4 per cent of the boys and 1.3 per cent of the girls. These variations consisted in modifications of the duration, intensity, or frequency of one or the other of the three groups of vibrations described. The more common of these variations are illustrated in Figure 5 and are characterized by (1) unusual prolongation, (2) imperceptibility of one or the other of the component sets of vibrations, (3) a distinct splitting and separation of the whole first sound into two groups of waves.

It should be noted that of the thirty-four cases of variations in the

pattern of the first sound, the majority, or 62 per cent, were detected at the mitral area alone, 15 per cent could be perceived in all three areas examined, 12 per cent in both the mitral and pulmonic, and 12 per cent in the pulmonic area alone. None was recorded from the aortic area alone. Thus, in order of frequency, the variations described have been perceived first at the mitral area, secondly at the pulmonic, and last at the aortic area.

3. SYSTOLIC INTERVAL

In the basic pattern of the cardiac cycle, i.e., in the pattern corresponding to the "normal" physiological state of the heart, there occurs an interval of silence between the termination of the first and the beginning of the second sound. On the stethogram the basic pattern of this systolic interval is represented by a segment of smooth base line as shown in Figures 2 and 4. The basic pattern is not, however, the typical or most common pattern of the systolic interval so far as this sample of children is concerned since it is observed in only 41 per cent of the stethograms.

Interruption of the interval of silence by sounds of varied pitch, duration, and loudness constitute the variations from the basic pattern. These interrupting sounds, the murmurs heard on auscultation, are manifest on the stethogram by waves which replace in whole or part the smooth base line between the first and second sound. It is necessary to point out that not all similar stethographic modifications of the systolic interval can be perceived on auscultation. In fact, Wiggers (41) (42) suggests that in children there may be normally a group of vibrations following the first sound but which are not sufficiently intense to be appreciated by the ear. Since not all of these recorded variations of the systolic interval can be regarded as murmurs they shall be called here systolic vibrations, and thus any implication of pathology that may be read in the word "murmur" will be avoided.

Systolic vibrations were encountered in 59 per cent of the chil-

dren. In the majority of the cases—78 per cent—they were perceived at all three chest areas examined; in 8 per cent they were perceived in the mitral and pulmonic area only; in 4 per cent at the mitral area alone, and in an equal percentage only at the pulmonic and aortic areas. Thus, while all areas may be regarded as favorable positions to detect systolic vibrations, the mitral (apex) and pulmonic (base) areas are the most favorable. This fact accords well with the conclusion reached by Thayer (35) and by Fahr (15) that the systolic murmurs so frequently observed in children often are due to turbulence of blood-flow and consequently are well heard at the base of the heart.

The intensity of the systolic vibrations can be graded by observing to what degree they replace the base line in each instance. Inspection of the tracing, particularly along its longitudinal axis, reveals that as the amplitude of the group of vibrations increases the base line narrows until there appears to be a loss of its continuity. Therefore, it has been possible to classify the intensity of the systolic vibrations into three grades which, so far as can be learned from this sample, appear to be easily and clearly distinguishable. The three grades of this classification have been termed: perceptible, definite, and marked.

The systolic vibrations are called "perceptible" when the base line maintains its full width but the upper and lower edges have a roughened or saw-toothed appearance (*cf.* Figure 6). "Definite" systolic vibrations are called those in which the saw-teeth are more pronounced and accompany a definite narrowing of the base line which is, however, continuous throughout the interval. The term "marked" is applied when the systolic vibrations replace completely the base line for a certain part of the interval. As the amplitude increases the base line disappears only to reappear when the vibrations decrease in amplitude. In this sample, the perceptible systolic vibrations are the most common, being found in 36 per cent of all the children (61 per cent of all systolic vibrations); definite systolic

vibrations were found in 20 per cent of the children (34 per cent of the systolic vibrations), while marked systolic vibrations were found in only 3.0 per cent of the children (5 per cent of all the children with systolic vibrations). It is a well-established fact that during childhood and adolescence systolic murmurs, believed to be functional, are commonly observed. As it has been said, not all cases of systolic vibrations could be perceived as murmurs by auscultation, nor is it desired to imply that the systolic vibrations are identical to murmurs. However, it is with regard to such variations of the basic pattern of the cardiac cycle that objective and permanent records are most useful. When the appearance of the audible murmurs can be definitely identified on the stethogram it is hoped that repeated examinations will allow a clearer understanding of the significance of these variations in relation to health and disease.

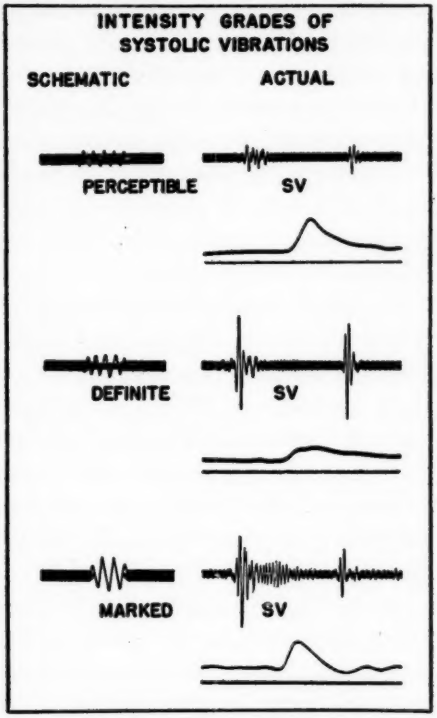

Fig. 6. Schematic representation of the threefold classification of systolic vibrations according to grade of intensity and examples from actual stethographic records. SV means systolic vibrations.

4. SECOND SOUND

The second sound is composed of a series of vibrations of short-

er duration than the first, and somewhat higher in frequency (pitch). Wiggers says that their wave frequency is from 50 to 70 double-vibrations per second. The onset of the second sound typically is abrupt and the vibrations undergo a rapid decrement to the base line (*cf.* Figures 2 and 4). In general the waves form two distinct groups: one composed of 1 to 2 waves of high amplitude, the other contains 3 to 4 waves of low amplitude. The change from high to low amplitude is abrupt and often marked with a slight slurring or notch at the junction point of the two groups of waves. These are the characteristics of what may be called the basic pattern of the second sound. In this material it was found in 84 per cent of the children.

Variations from the basic pattern of the second sound may occur relative to duration, intensity, and frequency of the sound. In this sample, however, only a modification relative to duration was observed (*cf.* Figure 5). This variation consisted of a distinct separation of the two groups of vibrations, in some cases with a portion of the flat base line appearing between the two groups. In addition, the second group of waves instead of having a low amplitude had one which was almost equal to that of the first group of vibrations. This variation may be regarded as the stethographic equivalent of the clinical "split" second sound. In this sample it has been found in 285 cases, or 16 per cent of the children. In all except twenty-three instances it was detected at the pulmonic area only. This is in agreement with the general view [*cf.* Wolferth and Margolies (43)] that the reduplicated or split second sound is heard best at the base. It should be remarked that in nine children this variation was observed either at the mitral or at the aortic area only.

5. THIRD SOUND

Depending upon the point of view and definition adopted, the third heart sound may be regarded as a variation from, or a normal constituent of, the basic pattern of the cardiac cycle. Described in

detail first by Thayer (34) who used auscultatory procedures, the third sound has been remarked on the stethograms by Braun-Menéndez (6) and Caeiro and Oriás (8) particularly. It consists of vibrations that are variable in number, duration, and amplitude, although the amplitude is usually low (*cf.* Figure 4). According to Braun-Menéndez (6), the third sound appears in most cases from 0.11 to 0.14 seconds after the beginning of the second sound and coincides with the "r" wave of the venous pulse. In other words, the third sound apparently coincides with the end of the rapid diastolic filling phase.

From the findings in this sample it would seem that the condition is not so rare since it was observed in 13 per cent of the children. In all but seven cases the third sound was detected at the mitral area alone.

The percentage of third heart sounds uncovered here is much lower than that reported by Thayer (34) after examining 231 presumably healthy persons, children and adults combined. In the total sample 65 per cent were found to have third heart sounds, but considering only the children almost 90 per cent had this condition. The large number uncovered by Thayer results from the fact that, as he noted, third heart sounds are heard best with the subject in a dorsal decubitus position. On the other hand, with the subject sitting (and thus in a position more nearly the same as that used here) Thayer was able to hear third heart sounds in only 13 per cent of the children examined. This figure, it will be noted, is identical to the one reported here.

6. DIASTOLIC INTERVAL

Above it has been mentioned that following the second heart sound, in the basic cardiac cycle pattern, an interval of silence occurs, terminated by the beginning of the first sound of the succeeding cycle. On the stethogram this, the diastolic interval, is represented by a segment of smooth base line, as illustrated in Figures 2

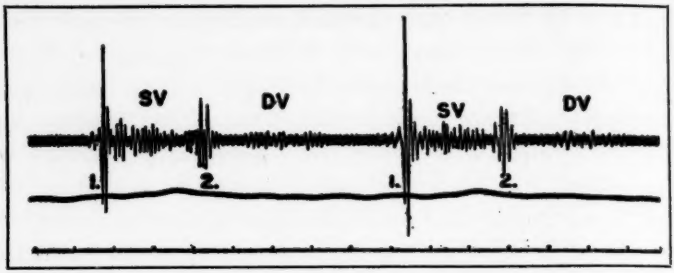

Fig. 7. Actual stethographic record showing diastolic vibrations. In this case marked systolic vibrations are also present. DV means diastolic vibrations, SV means systolic vibrations, 1. indicates first sound, 2. indicates second sound.

and 4. In certain instances and generally associated with frank pathological conditions, the period of silence is interrupted by the presence of so-called murmurs. Corresponding to the murmurs heard by the ear, the stethograph records vibrations which replace[3] in whole or in part the smooth base line. An example of these vibrations, here called diastolic vibrations and regarded as a variation from the basic diastolic interval pattern, is shown in Figure 7. Since the instrument can record sounds which are too faint to be heard by the unaided ear, it must be remembered that, as in the case of systolic vibrations, there may be present vibrations on the stethogram when no murmurs are perceived by simple auscultation.

In this sample of children only seven, or 0.5 per cent, were found to have stethograms showing diastolic vibrations. The small number observed may probably reflect the fact that diastolic murmurs are generally the expression of a diseased state of the heart.

Frequency of the Basic Pattern and its Variations

The occurrence of the above described variations from the basic pattern is summarized in Figure 8. It is seen that bigeminy, diastolic vibrations, and extrasystoles have been observed in less than one

[3] It has already been remarked that the diastolic interval may be broken by the presence of a third heart sound, but in this case the residual interval is still registered as a smooth base line.

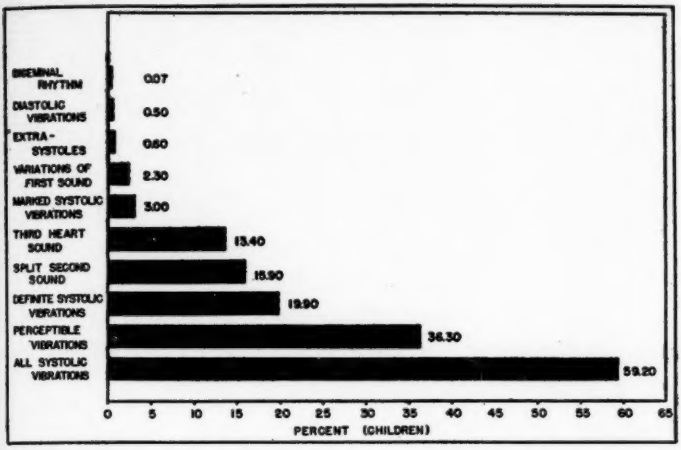

Fig. 8. Per cent of children whose stethographic records show the stated variations from the basic cardiac cycle pattern.

per cent of the children. Variations from the basic pattern of the first sound and systolic vibrations of a marked degree are more numerous and have been noted in 2 to 3 per cent of the sample. Variations characterized by the presence of the third sound, a split second sound, or definite systole vibrations are far more common, being found in 13 to 20 per cent of the children. The most common of all the variations are the perceptible systolic vibrations which occur in over one-third of the subjects. If all grades of systolic vibrations are taken together, then the data show that such variations are present in the stethograms of over half of the children.

It is obvious from the findings discussed above and in the preceding section that the typical stethographic pattern of the cardiac activity of children is not represented by the basic pattern (*cf.* Figure 2) alone but includes one or more of the variations described. This is clearly seen in Figure 9, which presents the percentage of the children whose stethograms show the basic pattern only, of those who have also perceptible systolic vibrations, and so on; the

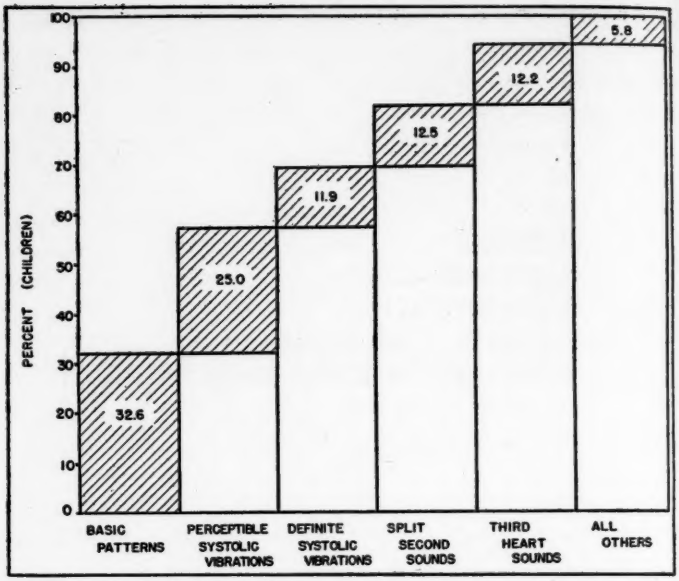

Fig. 9. Per cent of children whose stethograms show: (1) only the basic pattern, (2) a stated variation alone or accompanied by one of more frequent occurrence in the sample (*cf.* Fig. 8). The height of the cross-hatched bar indicates the percentage of children with stethograms showing the stated pattern alone or together with those mentioned to the left on the abscissa. The total height of the bar equals the percentage of children whose stethograms have one or all of the patterns stated so far on the abscissa.

order of the inclusion of the variations being based on their order of frequency in the sample as given in Figure 8. Thus, the data of Figure 9 indicate that less than a third of the children have stethograms that show only a basic pattern. Since altogether in 25 per cent of the cases perceptible systolic vibrations was the only type of variation noted, it means that 57.6 per cent of the children had either a basic pattern alone or one accompanied by perceptible systolic vibrations. Similarly, it is seen that almost 70 per cent of the children gave stethograms that revealed either a basic pattern alone or one that included perceptible and definite systolic vibrations, while in 82 per cent of the cases a split second sound was also observed at times.

In 94.2 per cent of the children there was found either a basic pattern alone or one that contained perceptible or definite systolic vibrations, a split second sound, and a third sound but no other form of variation from the basic pattern of the cardiac cycle.

Without introducing corroborative clinical and laboratory information, no attempt can be made at this time to pass judgment on the pathological significance of these findings unless one assumes, as is too often done, that rarity is synonymous with abnormality. In this paper, purposely limited only to a description of the observations, it is sufficient to remark that the children whose stethograms showed either bigeminy, extrasystoles, splitting, etc. of the first sound, diastolic vibrations, or marked systolic vibrations constitute 5.8 per cent of the sample. It would be expected that in this group are included a considerable proportion of the cases of cardiac dysfunction.

Sex and Age in Relation to Pattern of Stethographic Records

Since there is a sex difference in the mortality and the morbidity from diseases of the heart and circulatory system [*cf.* Ciocco (9)], it is of particular interest to inquire if in childhood a sex difference in the frequency of the patterns of the heart sounds is to be noted. As a matter of fact, some, although not very striking, differences are demonstrable. The basic pattern of the cardiac cycle was found less often in boys than in girls, the percentages being 28.7 and 36.2 respectively. The difference is statistically significant and indicates that, taking all forms of variations, they occur definitely more often in males than females. Considering individually the more common forms of variations, their higher frequency among the boys is true for all grades of systolic vibrations (boys 61.5 per cent, girls 57.2 per cent), split second sounds (boys 18.6 per cent, girls 13.3 per cent), and for splitting, etc. of first sound (boys 3.4 per cent, girls 1.3 per cent). On the other hand, third heart sounds occur in 14.8 per cent of the girls and only 11.8 per cent of the boys. It is to be

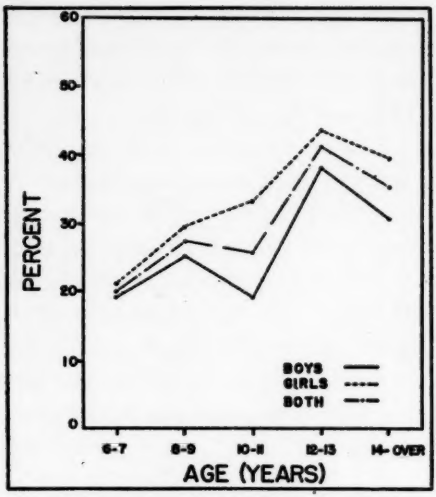

Fig. 10. Per cent of children of stated age whose stethograms show a basic pattern alone.

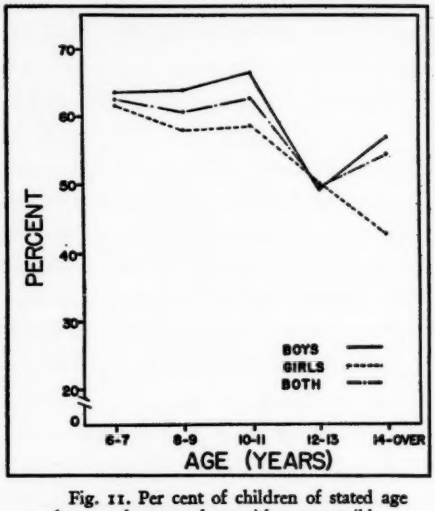

Fig. 11. Per cent of children of stated age whose stethograms have either perceptible or definite systolic vibrations, or both.

realized that for none of the forms of variations mentioned is the difference between the boys and girls sufficiently large to be judged as definitely significant in terms of the sampling error. Altogether they are suggestive, however, and deserve to be investigated further as possible explanations of such sex differences as, for example, the higher incidence of endocarditis in females and of the degenerative forms of heart disease in males.

The higher frequency of the basic pattern of the cardiac cycle in girls is found at all ages. This is demonstrated in Figure 10 in which are given for each two-year age group the percentages of boys and girls whose stethograms showed the basic cardiac cycle pattern only. Moreover, it is seen that for both sexes the percentages tend

to become higher with increasing age—relatively more of the older children have a basic cardiac pattern than do the younger ones. Therefore, on the whole, variations are more common in younger than in older children. For systolic vibrations, perceptible and definite combined, the expected age trend is not so regular although from Figure 11 it is apparent that there are relatively less children with these grades of systolic vibrations after 12 years of age than before. The irregularity in the age trend in part may be the result of aggregating all kinds of systolic vibrations, those perceived at only certain chest areas together with those detected at others. In fact, if only the systolic vibrations that were perceived at all three chest areas of the subject are considered, it is found—as will be noted in Figure 12—that the age trend becomes smooth and regular. Among the youngest children systolic vibrations are uncovered over one and one-half times more often than among the oldest. Moreover, it is also seen that with the exception of the 12-13 age group the percentages are higher in the boys than in the girls.

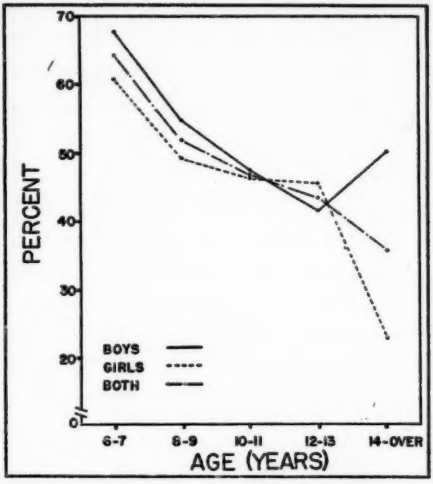

Fig. 12. Per cent of children of stated age whose stethograms show systolic vibrations that were detected at the mitral area only or at the mitral and also at other areas.

Split second sounds also occur somewhat less often in the older than in the younger age groups; however, for the boys particularly the age trend is not consistent in one or the other direction (*cf.* Figure 13). The percentages increase with age until 10-11 years, and

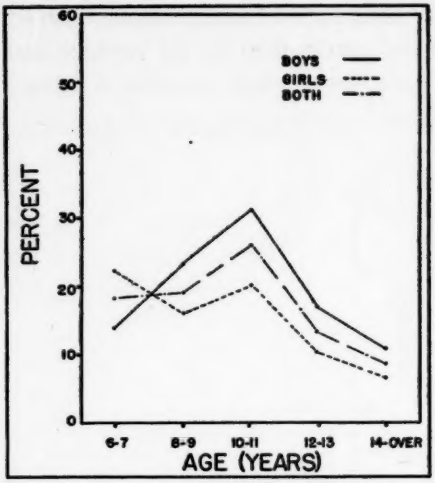

Fig. 13. Per cent of children of stated age whose stethograms show a split second sound.

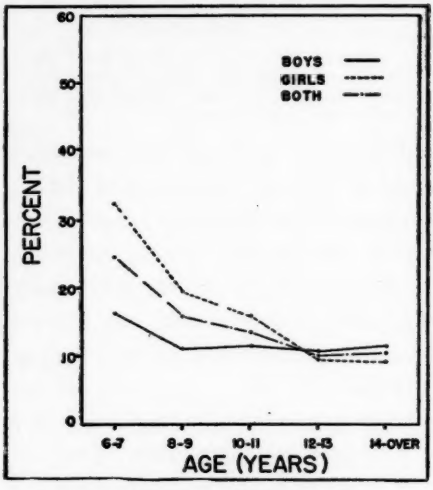

Fig. 14. Per cent of children of stated age whose stethograms show a third heart sound.

then decline thereafter. Although the data for the girls reflect a similar sequence, they appear to show a little more definitely that the frequency of this type of variation from the basic cardiac cycle pattern decreases with increasing age.

A relatively greater number of girls having third sounds is to be found, as illustrated in Figure 14, from the ages 6 to 11 inclusive. Thereafter, there is little sex difference although the percentages are slightly higher in the boys. Taking both sexes together it is seen that the frequency of the third sound also decreases more or less with increasing age, it being found over two and one-half times as often in the youngest as in the oldest age groups. However, when the sexes are considered separately the

regular trend appears only for the girls and is not at all evident for the boys, who, in fact, seem to present a constant rate at all ages after 8 years.

Summing up these findings relative to age and sex, two interesting series of facts stand out. In the first place, between the boys and girls differences are manifest relative to the frequency of the stethographic patterns of heart sounds and also with respect to the constancy of the age trends in rates. For the time being no adequate explanation can be offered for such diversities. Besides assuming that they might be associated with sex differences in the morphology and function of the cardiovascular system, one should also consider that the contour and structure of the chest do not develop in the same manner in the two sexes.

The most important results here shown are those indicating that in general with increasing age there is a decrease in the variations from the basic cardiac cycle pattern. In this case also one might regard the trend as the effect of the age changes in the form and structure of the thorax, changes that possibly might impair the transmission of heart sounds to the surface. On the other hand, the age trend may be the consequences of real alterations in the cardiac activity, since it is generally assumed that in childhood the variations from the basic pattern are the expressions of physiological states peculiar to this age period. Accepting this view, the important question arises as to whether the manifestation of variations in childhood is associated with the acquisition of heart disease in later life. It is hoped that as the investigation proceeds, through the repeated examination of these children and through the intensive study of children and adults with heart disease, a definitive contribution will be made towards answering this important question. In the meantime, from the results of this study based on an unselected population of children it is possible to set up tentative standards useful for the analysis of stethographic records of the cardiac cycle by means of simple inspection. The results obtained by means

of measurements of the stethographic records of the cardiac cycle and its elements will be presented in a paper that follows.

Summary

This paper presents: (a) an outline of a program of investigation of the cardiac activity of children, of the means of measuring it objectively, and of detecting cardiovascular diseases through surveys; (b) the results of a first analysis of the stethographic examination of 1,482 children.

The stethographic basic pattern of the cardiac cycle, the pattern which corresponds to the "normal" as heard on auscultation, together with its variations, has been described qualitatively in detail.

In this sample the basic pattern was found in less than one-third of the children. Among the variations observed the most common single form is that constituted by systolic vibrations (some of which are the murmurs heard on auscultation) found in the stethograms of 60 per cent of the children. Next in order of frequency are "split," or reduplicated second sounds, found in 16 per cent of the children, while third heart sounds were observed in 13 per cent.

Among the less common variations, splitting and other peculiarities of the first sound occurred in 2 per cent of the children, while in less than one per cent were found examples of extrasystoles, bigeminy, and diastolic vibrations (murmurs).

A basic cardiac cycle pattern is found more often in girls than in boys, and consequently, taking all forms of variation together, they are found more often in boys. However, third sounds apparently constitute an exception since they are observed more often in girls.

On the whole, variations are found more often among the youngest children, and their frequency decreases with increasing age. Correlatively, a basic cardiac cycle pattern is noted less often among the youngest children and more often among the oldest children.

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THE NATURE OF NUTRITIONAL DISEASES OCCURRING IN THE SOUTH[1]

W. H. SEBRELL[2]

WHEN nutritional diseases in the South are mentioned, there is always one disease that stands out above all others. This is pellagra, and because of its high incidence, it *should* attract our attention first. It is by far the most serious of our deficiency disease problems. However, we should not let this fact blind us to the existence of other deficiency diseases in this part of the United States. It is to be expected that other dietary deficiency diseases will also develop in an area in which a large number of people live on a diet restricted enough to produce pellagra. You cannot expect a generally poor diet to be deficient in only one respect, and there is ample evidence that other deficiency diseases such as scurvy, beriberi, nutritional edema, and nutritional anemia occur in the South. There are occasional reports of cases of beriberi, and there is evidence that vitamin B_1 deficiency may be more widespread than was thought a few years ago. Spies and his associates have found that the peripheral neuritis which is frequently seen in cases of pellagra responds to the administration of vitamin B_1, a strong indication that these cases really are suffering from a multiple vitamin deficiency.

Another deficiency disease in the South associated with these same types of diet is nutritional edema, which was discussed at the Milbank meeting last year by Dr. Youmans.[3] This condition appears to be due to a protein deficiency and usually manifests itself

[1] Presented at The Round Table on Nutrition: Its Public Health Aspects, Seventeenth Annual Conference of the Milbank Memorial Fund, March 23-24, 1939.

[2] Surgeon, United States Public Health Service.

[3] Youmans, John B.: The Diagnosis of Nutritional Edema with Particular Reference to the Determination of Plasma Proteins and Consideration of their Behavior. NUTRITION: THE NEWER DIAGNOSTIC METHODS. Proceedings of the Round Table on Nutrition and Public Health, Sixteenth Annual Conference of the Milbank Memorial Fund, March 29-31, 1938, pp. 166-173.

by unexplained swelling of the feet and ankles. We do not know how much of it occurs in the South, but its prevention involves the same factors that are concerned in the prevention of pellagra, and the use of proper methods for the prevention of pellagra will also prevent this as well as the other deficiency diseases that are peculiar to the South.

Table 1. Total number of deaths from pellagra as reported to the Public Health Service, compared with those as published by the Bureau of the Census for the years 1930 to 1937, inclusive.

Year	Deaths Reported to the Public Health Service	Deaths as Published by the Census Bureau
1930	7,146	6,333[1]
1931	5,855	5,091[1]
1932	4,134	3,694[1]
1933	3,821	3,955
1934	3,409	3,602
1935	3,463	3,543
1936	3,634	3,740
1937	3,162	3,258

[1] The Registration Area includes only forty-seven states: Texas being the only state not in. In 1933 and subsequent years, the Registration Area includes all states.

You who are here at this meeting have already heard much about pellagra and these other nutritional diseases, and there is no need for me to discuss the well-known observations on them. Instead, I shall discuss briefly some of the practical aspects of the prevention of nutritional diseases in the South and present some new observations that tend to further complicate our problems.

Last year at this meeting there was a presentation on the relation of nicotinic acid to pellagra.[4] Nicotinic acid has proven its value as a therapeutic agent in pellagra, but I am afraid it has only opened up new problems in prevention. It is too early for the beneficial effects of the use of nicotinic acid to show up in our mortality statistics, but it is to be expected that in the next few years we shall see a marked decrease in the deaths from pellagra, although I see little prospect for any marked diminution in the incidence of the disease. The number of deaths from pellagra in the United States for the

[4] Spies, Tom D.: The Relation of Nicotinic Acid to Pellagra as Evidenced by Therapeutic Studies and its Implications for a Diagnostic Test. NUTRITION: THE NEWER DIAGNOSTIC METHODS. Proceedings of the Round Table on Nutrition and Public Health, Sixteenth Annual Conference of the Milbank Memorial Fund, March 29-31, 1938, pp. 103-113.

period 1930 to 1937 is given in Table 1. This shows very clearly that we have made definite progress in reducing our mortality. Unfortunately, we are unable to tell whether this represents better treatment due to the widespread application of our knowledge of the disease or whether it represents a reduction in the number of cases that occurred. I am inclined to think that both of these things are taking place.

Table 2. Deaths and death rates (number per 100,000 estimated population) from pellagra in certain states, 1937.

Area	Number	Rate
United States	3,258	2.5
Alabama	309	10.7
California	74	1.2
Florida	104	6.2
Illinois	19	0.2
Iowa	6	0.2
Kentucky	86	2.9
Massachusetts	13	0.3
Mississippi	234	11.6
Missouri	20	0.5
New York	25	0.2
North Carolina	332	9.5
Ohio	19	0.3
Pennsylvania	15	0.1
South Carolina	272	14.5
Tennessee	203	7.0
Texas	578	9.4
West Virginia	11	0.6

Table 2 shows the number of deaths from pellagra and the rate per 100,000 for certain states in 1937. Although the rate is high in the southern states, pellagra is not an exclusively southern disease. It occurs to some extent in every state, and in several the death rate reaches an appreciable figure. In some southern states pellagra stands about fifteenth as a cause of death, exceeding the number of deaths from such diseases as typhoid fever, diphtheria, measles, and poliomyelitis, diseases which we usually associate with the activities of the health department.

It would be very desirable to know the actual number of cases of pellagra occurring in the United States. For some selected states, the reported numbers of cases and deaths are presented in Table 3. In several instances, the number of deaths reported from the disease even exceeds the total number of cases reported, and it really would be better if we had no case reporting at all since the figures are so misleading. For some years I have been estimating the number of cases on the basis of the reported deaths representing about 3 per

State	1934		1935		1936		1937	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Alabama	374	309	563	254	300	306	270	311
Arkansas	523	184	646	186	272	213	463	148
Florida	151	230	74	181	35	133	115	103
Georgia	643	351	707	365	701	391	836	370
Kentucky	131	58	73	68	56	72	47	75
Louisiana	199	143	218	136	161	115	159	101
Mississippi	4,157	211	3,963	222	3,693	264	3,699	236
North Carolina	543	424	732	387	831	349	576	327
South Carolina	1,470	329	1,237	300	1,807	274	2,263	269
Tennessee	147	227	253	215	288	244	277	204
Texas	782	493	546	602	589	645	1,676	508
Virginia	237	124	149	141	148	130	110	110

Table 3. Number of cases and deaths from pellagra reported in selected states for 1934 to 1937.

cent of the cases, a rate obtained from Goldberger's survey in South Carolina many years ago. This gives an estimate of about 100,000 cases for 1937, an astounding figure, but one which I believe is conservative because the death rate today probably is lower than it was at the time of Goldberger's survey. During the summer months I have followed the country roads in several southern states and found case after case of pellagra simply by stopping at a house and asking if anyone in the neighborhood had the disease. Fortunately, it is a mild disease in most cases, as is indicated by the low death rate and by the number of cases that can be found who have never had medical attention. I have even found severe skin lesions on a man ploughing a field.

Although we have known how to prevent pellagra for years, we find the health departments busily fighting diphtheria, measles, and smallpox, but doing very little about pellagra. Now, do not misunderstand me; I am not criticising the health departments. After I explain the difficulties you will see why the problem is one that they cannot handle and one which they should not be expected to handle alone, although they can do their share. Many are already doing as much as can be expected of them. First, it is difficult to get

money for a pellagra campaign. Since the disease is not contagious, no horrible picture of its menace to the community can be drawn by the health officer; secondly, since it attacks those on the lowest economic level, the sufferers themselves are unable to contribute to their relief and at the same time they constitute the least influential group in the community; thirdly, the health officer cannot see how he can organize and conduct a satisfactory campaign; and, finally, there is no way for him to present figures proving his industry in this field as he can with other diseases by showing numbers immunized, x-rayed, vaccinated, etc. These factors in most communities result in the health department's campaign against pellagra consisting of the distribution of pamphlets on the subject, and the giving away of much dried yeast, the latter probably saving many lives, but being a palliative measure which will never solve our problem.

In addition to these causes, there are other reasons why the health departments are almost helpless. Let us take an actual case: Early in March, I was in a rural southern county that cannot afford a health officer, and stopped to see a reported case of pellagra. (The season starts at this time and cases occur with increasing frequency up into the summer, when they disappear following the use of the more liberal summer diet.) I found a small lady, probably in her fifties, with a typical case of pellagra. I advised her to drink milk and eat some lean meat and green vegetables if she wanted to get well. With tears in her eyes, she said, "Doctor, I can't get it. My children are no good. They won't help me, and everything in the world I have is $3.00 a month that the county gives me." What are you going to do with a case like this? I then advised her to go to the county nurse and get some dried yeast. She told me she had already been there but couldn't get any. I then visited the county nurse and found that her supply of yeast had been exhausted for months; she had been unable to get more and had a list of people who had been asking for it. I then had a talk with some of the in-

fluential men in the county, and they said, "Doctor, the County is broke. We are closing the schools next Friday because we can't pay the teachers." I saw other cases of pellagra in this same county, and there probably will be dozens there before the summer is over. What can the state health department do about it without assistance? Under present circumstances, nothing, except distribute yeast and try to keep the mortality down. But there are two things that can be done that will solve the problem if the proper agencies will work with the health department. These are (1) education and (2) crop diversification—measures which Goldberger and those who have followed him in the Public Health Service have been preaching for more than ten years.

Marzari, one of the great Italian pellagrologists, wrote an appeal to Eugene Napoleon in 1810 begging him to control pellagra by education and the eradication of poverty. I don't believe we will ever eradicate poverty, but I do believe we can eradicate our pellagra by crop diversification even if this leaves our poverty unchanged.

When I say education, I am using the word in a broad way. I mean not only the teaching of the necessity for eating an adequate diet, but also detailed instruction on how to produce, preserve, and prepare the necessary foods. At least one properly balanced meal should be served to the school children each day in order to educate the palate and cultivate a taste for desirable foods at an early age. I have found numbers of pellagrins who refused to include milk and green vegetables in their diet because they had not learned to like them.

By crop diversification I mean the production of food and forage crops. In looking for pellagra, I long ago learned not to waste my time stopping at a house with livestock and with a large vegetable garden around it. Here, then, is the solution of our pellagra problem, stated in a few words. However, the problem is so further complicated by such things as freight rates, industrial development, the price of cotton, the price of tobacco, the production of turpentine,

and numerous other factors, that the practical application of these measures is one of the most difficult problems facing the South today. In other words, it is so tied up with economic conditions that it is beyond the power of the health departments to solve it without help. A health department alone cannot sell a program of crop diversification, and the development of health education as an integral part of our secondary school curriculum is still in its infancy. Progress is being made. The South of today is a different South from that of ten years ago. Industry is moving in, livestock raising is increasing, and crop diversification under government stimulation in the face of an unprofitable cotton market has made great strides. This is a start in the right direction, in which the eradication of pellagra, if it has been considered at all, has played a very minor rôle. The big thing that is lacking and the essential thing that must be developed if pellagra and the other nutritional diseases are to be prevented in the South is an adequate program of health education directed particularly toward nutrition. This is not the place to go into the details of the organization of such a program, which must necessarily vary from state to state. The important thing here is to recognize that there is an urgent need for such a program. A few of the southern state health departments have added a nutritionist to their staff. This is desirable, but it is a feeble effort to meet the situation, and more heroic methods are needed. In one southern health department the nutritionist is devoting practically all of her time to a dental hygiene program. There is a certain amount of grim humor in the fact that her efforts are being devoted to attempts to control conditions whose etiology is unknown, when pellagra is widespread in the same state. However, regardless of what the objective may be, her efforts to improve the diet, if successful at all, probably will reduce the pellagra just as much as if that were her objective.

Neither the health departments, nor any other one group or class of people or organization can be blamed for our pellagra and our

failure to eradicate it. It is a monument to the failure of our social order to properly care for its people, and a manifestation of the low economic level to which an entire section of the population of this enlightened nation has been permitted to sink. There has been a tendency to blame it on the plantation owner and the textile mill operator, but this is a short-sighted view. You might just as well blame it on the government. For example, unequal freight rates make it cheaper to deliver New England granite to the market than to deliver Georgia granite, with the result that the Georgia granite quarries close and the loss of income to the granite workers of Georgia makes them eligible for pellagra. So let us not be too hasty to blame anyone for our pellagra. Instead, keep in mind that anything that operates to improve the food supply in the South will operate to reduce our pellagra incidence, and in the meantime the most effective weapons we can develop and use are health education and crop diversification, while we keep our mortality down with the use of palliative measures such as dried yeast and nicotinic acid.

I mentioned earlier in this paper that nicotinic acid has added to our problems of pellagra control rather than simplified them. One of the most serious problems in this connection is whether nicotinic acid should be added to some commonly used southern food, such as cornmeal. There are many objections to such a procedure, and, in my opinion, it would be unwise to do such a thing at this time, particularly since we do not know either the quantity of nicotinic acid necessary to prevent pellagra or the factors governing the individual's requirements.

There is now no question that nicotinic acid is an effective therapeutic agent in the treatment of pellagra. In view of the presence of other deficiency diseases, however, as well as the possible presence of unrecognized subclinical stages of deficiencies, it seems much wiser to continue to try to prevent pellagra by improving the diet.

In addition to the deficiency diseases already mentioned, my associates and I have recently found that there is another deficiency

disease present in the South which has hitherto been unrecognized. This is a clinical syndrome due to riboflavin deficiency,[5] and we have therefore designated it "ariboflavinosis." It is characterized by lesions in the angles of the mouth which begin as a pallor of the mucosa of the lips, followed by maceration, and within a few days superficial transverse fissures appear, usually bilateral and exactly in the angle of the mouth. These fissures showed a tendency to extend onto the face rather than the buccal mucosa. It appears that we have here a deficiency disease different from pellagra in both etiology and symptomatology, but which has been confused with pellagra in the past because the two conditions have so frequently occurred together and because the foods which contain the pellagra-preventive factor also usually contain riboflavin.

I call your attention to this differentiation particularly because the symptoms do not respond to nicotinic acid therapy. If we attempt to substitute nicotinic acid for natural foods in the prevention of pellagra it is not unlikely that ariboflavinosis or some of the other deficiency diseases present in the South will simply take the place of pellagra as a public health problem. I am of the opinion that it is wiser to continue our efforts to improve the food supply with natural, readily available foods which can be produced at home at little cost and which will not only prevent the specific disease we happen to be aiming at, but will also prevent all other nutritional diseases and at the same time furnish that optimum degree of good health, comfort, and mental ease which is popularly associated with a stomach well-filled with the end products of a diversified crop.

[5] Sebrell, W. H. and Butler, R. E.: Riboflavin Deficiency in Man. *Public Health Reports*, United States Public Health Service, December 30, 1938, 53, No. 52, pp. 2282-2284.

THE DIFFERENTIAL FERTILITY AND POTENTIAL RATES OF GROWTH OF VARIOUS INCOME AND EDUCATIONAL CLASSES OF URBAN POPULATIONS IN THE UNITED STATES

BERNARD D. KARPINOS[1] AND CLYDE V. KISER[2]

PAST studies of differences in fertility by socio-economic status have been restricted in large part to married women. This procedure has served to hold constant the variable of proportions married and in this sense has the virtue of any other type of standardization. Nevertheless, it is not through choice that there exist so few attempts at analyses of fertility of socio-economic classes based upon total female populations of childbearing age, irrespective of marital status. In view of the interest in reproduction rates (indices of the extent to which the fertility of population groups exceeds or falls short of replacement needs) as applied to large areas or countries as a whole, there is increasing desire to learn more about the potential rates of growth of groups classified along socio-economic lines. For a long time, too, students of population have recognized that a precise determination of variations in proportions married in relation to class differences in fertility constitutes one of the outstanding gaps in the literature.

Given the proper data, analyses of class differences in fertility, based upon all women of childbearing age regardless of marital status, would serve two important purposes. They would permit the computation of indices of population replacement and, used in conjunction with rates relating to marital fertility, would allow a more adequate interpretation of the character and trends of group differences in fertility. The latter function is of particular interest at the present time. Recent analyses have indicated that in so far

[1] From the Division of Public Health Methods, National Institute of Health, United States Public Health Service.

[2] From the Milbank Memorial Fund.

as urban native-white married women are concerned, there has emerged an exception to the traditional pattern of consistent inverse association between nuptial fertility and socio-economic status.[a] This exception consists in the failure of the wives of topmost socio-economic status to be universally characterized by lowest nuptial fertility. It is patently of interest to find out whether such indications persist when the analysis is made with reference to all women.

The dearth of studies of class differences in fertility relating to all women is due to the lack of available suitable data. Official data of the type required are available only for broad demographic groupings, such as those by area, type of community, color, or nativity. Furthermore, the requirements for analyses of this type have not generally been fulfilled by data collected under private auspices.

Although they afford no ideal approach to this problem, the fertility data collected by the National Health Survey have been studied from this point of view. Specifically, the present report is designed to give some indication of the potential rates of growth of urban white groups classified according to income and educational status, and to compare the present status of differential fertility in urban white populations when the factor of variation in proportions married is allowed to operate and when it is held constant.

SOURCE OF DATA AND DEFINITION OF TERMS

The National Health Survey was conducted by the United States Public Health Service, with assistance from the Works Progress Administration, during the fall and winter of 1935-1936. Though mainly designed to secure comprehensive data on incidence and severity of illness, material collected in the course of the *Survey* included

[a] *See* (a) Notestein, F. W.: Differential Fertility in the East North Central States. The Milbank Memorial Fund *Quarterly*, April, 1938, xvi, No. 2, pp. 173-191. This study is based on previously unpublished family data from the 1930 Census for the East North Central States.

(b) Kiser, C. V.: Birth Rates and Socio-Economic Attributes in 1935. The Milbank Memorial Fund *Quarterly*, April, 1939, xvii, No. 2, pp. 128-151. This study is based on fertility data for urban married women of childbearing age canvassed by the National Health Survey.

important population data. Detailed records were secured in a house-to-house canvass of some 700,000 families in eighty-three cities[4] of eighteen states. The present report, however, is limited to consideration of the urban white population, including approximately 632,000 families and about 2,250,000 persons, and embracing 596,474 females 15-44 years of age, of whom 336,226 reported themselves as married. A complete discussion of the method of selecting cities and sampling procedures is available elsewhere, so it is only necessary to state here that the procedure was designed to yield geographic representativeness of the urban population for the broad Eastern, Southern, Central, and Western areas. Because of administrative costs, there was no attempt to secure a representative distribution of the urban populations according to size of city. The proportion enumerated in large cities was too high and in smaller cities too low.[5] In this report, however, efforts have been made to adjust the total urban rates for this deficiency.[6] Furthermore, within each city chosen, attempts were made by the *Survey* to secure a

[4] An additional city, Baltimore, was surveyed but was dropped from the tabulations due to atypical sampling procedure applied to its data. Special surveys were also conducted among about 37,000 households in selected rural areas of Michigan, Missouri, and Georgia, but they are not included in the present report.

[5] For a list of the surveyed cities and full description of sampling procedures, *see* Perrott, G. St.J.; Tibbitts, C.; and Britten, R. H.: The National Health Survey: Scope and Method of the Nation-wide Canvass of Sickness in Relation to its Social and Economic Setting. *Public Health Reports*, September 15, 1939, 54, No. 37, pp. 1663-1687.

The following table concerning representativeness of the *Health Survey* urban population with respect to geographic region and city-size appears on page 1667 of the report.

Region	Regional Distribution		Size	City Size Distribution	
	Health Survey	1930 Urban		Health Survey	1930 Urban
All	100	100	All	100	100
Northeast	37	39	500,000 or More	43	29
North Central	33	33	100,000–499,999	31	23
South	18	18	25,000– 99,999	14	19
West	12	10	Under 25,000	12	29

[6] The procedure was that of weighting the fertility indices for component area-size groupings according to the distribution of the 1930 Census urban population by corresponding area-size groups.

cross-section of its population with respect to socio-economic and demographic attributes. In all except one of the selected cities under 100,000 population, efforts were made at complete coverage of households, and within larger surveyed cities the sampling procedure was designed to be random.[7]

The *Survey* data pertinent to the present study include those concerning fertility and those permitting a classification of the population according to income and educational status. The births reported are those that occurred during the twelve months preceding the day of the canvass and are hence mainly as of the year 1935. The income recorded by the *Survey* relates to the total family[8] and represents total amounts received[9] during the survey year. Families identified as having been recipients of public assistance, such as work relief, direct relief, mothers' pension, pension for the blind, were classified "On Relief," irrespective of income.[10]

On the basis of returns concerning educational attainment of surveyed individuals, the females of childbearing age were divided for purposes of this study into the four groups: "entered college,"

[7] Census Enumeration Districts were generally used as bases for selection of areas in sampled cities. The Enumeration Districts, or approximately equal portions of them, were listed in serial order and random selection was made by choosing every third, fourth, tenth, or eleventh unit, depending upon the predetermined sampling ratio. Areas thus chosen were scheduled for complete enumeration.

[8] By coding definitions, the "family" included the head of the household and all persons in the household related to the head by blood, marriage, or adoption. If two or more unrelated persons made up a household, one was assigned as the head and only the income of the designated "head" was considered as the family income. For purposes of the present report, the income status of all persons unrelated to the head of the household was regarded as "unknown." *See* footnote 15.

[9] Income was defined to include salaries, wages, business profits, receipts from boarders and lodgers, and income from investments. Families were not asked to report the exact amount of income but to designate which of several income intervals was appropriate to their respective situations. For a more detailed discussion of this aspect of the *Survey*, *see* National Health Survey: The Relief and Income Status of the Urban Population of the United States, 1935. Bulletin C, Division of Public Health Methods, United States Public Health Service, Washington, 1938.

[10] Analysis of voluntary returns concerning income status of the relief group indicated that although a few reported receipts of $1,000-$1,499, the cases fell preponderantly in the "under $1,000" category. Thus, although fertility and reproduction rates are presented separately for the "relief" and "nonrelief under $1,000" groups, they are also shown in this study for the two groups combined.

"entered high school," "entered seventh or eighth grade," and "under seventh grade." It should be emphasized that the highest educational level *reached* (not necessarily completed) was the determining criterion for this classification.

The various rates used in this report may be defined as follows:

Crude Birth Rate. The number of live births during one year per 1,000 total surveyed population.

Standardized Nuptial Fertility Rate. The number of live births during one year per 1,000 *married* women 15-44 years of age, in a standard married population. The rate was standardized here on the basis of the age distribution of the *married* white females 15-44 in the United States, as computed from the 1930 Census reports.

Standardized General Fertility Rate. The number of live births during one year per 1,000 females 15-44, regardless of marital status, in a standard total population. This rate was standardized on the basis of the age distribution of the *total* white female population 15-44 years of age in the United States, as computed from the 1930 Census reports.

Gross Reproduction Rate. The average number of daughters that would be borne to each individual woman among a cohort of females who start life together, on the assumption that all females will live through the complete childbearing span and that their fertility at successive ages will conform to age-specific fertility rates existing at the present time (in this case, in 1935). The rate is computed by adding existing age-specific fertility rates for women of given groups, regardless of marital status, and expressing the sum on the basis of number of *daughters per woman.*

Net Reproduction Rate. The rate is derived by reducing the age-specific fertility rates in accordance with age-specific mortality rates prevailing among the groups considered. It removes the assumption that the women will live through the entire childbearing period and is therefore designed to indicate the average number of daughters that would be borne to each individual woman under existing age-specific *fertility* and *mortality* conditions applicable to the group.

Limitations of Data. Certain limitations accompany the data and these are described at this point. It was not possible to secure a satisfactory test of the completeness of enumeration of births in the

Survey, due to the lack of official resident birth rates for white urban populations at the time of the investigation. For the past several years the Bureau of the Census has simply published numbers of births (instead of birth rates) for urban populations, due to uncertainties of population estimates for cities since 1930. It may be noted, however, that the official crude birth rate for the total rural and urban populations, white and colored combined, was 16.9[11] in 1935 and on this basis the rate of 13.8 derived from the *Survey* data for urban white populations may not appear unreasonably low. There are, however, internal indications of some underenumeration, particularly in the South. Preliminary investigations have indicated that this factor is not of sufficient seriousness to affect greatly either the absolute height of the rates or the relative differences of the rates for socio-economic classes in the combined areas. Further study is needed to determine a satisfactory method of adjusting for this factor of underenumeration. In the meantime, the reader must bear in mind the possibility of some underenumeration in considering the various rates presented.

Since the present report includes rates for total and married female populations of childbearing age, questions arise concerning the general representativeness of the *Survey* with respect to proportions married. It was found that the proportions of surveyed white females reported as married were consistently smaller than the proportions married among white females of comparable age and city of residence in the 1930 Census.[12]

The highest relative, although low absolute, differences occurred in the 15-19 age group. After age 25, the relative and absolute disparities were slight but still in the same direction. In view of the drastic slump in the marriage rate during the early years of the

[11] Bureau of the Census: Vital Statistics, Special Reports. Washington, Department of Commerce, January 19, 1937, iii, No. 1, p. 1.

[12] Typical of the comparisons are those given below for cities of 100,000-500,000 population, by geographic area of city and by age of women. The Census ratios pertain not to all

(Continued on page 373)

depression, it appears likely that the discrepancies in marriage frequencies of the younger age groups evident in the comparison of the 1935 *Survey* and the 1930 Census may be in major part an actual difference rather than an underenumeration of marriages by the *Survey*. The *Survey*-Census variations in classification of separated women may partially account for the small discrepancies at older ages. A woman who was neither widowed nor actually divorced, but to all intents and purposes permanently separated from her former husband, was coded by the Census as "married" but as "WDS" (widowed, divorced, or separated) by the *Survey*. When these situations are taken into account, the surveyed sample seems to be substantially representative with respect to proportions married.

Perhaps more important are possible biases accompanying classification of the population by socio-economic status. When studies of class differences in fertility are not restricted to married women, it is essential that the criterion of classification be equally applicable to women who are single and to those who are married.[18] A corollary of this requirement is that the criterion selected should be of such nature that a woman's status is not changed by the event of marriage

cities of designated size and area but to weighted ratios for groups identical with those in the *Survey*. The weighting was done according to distribution of surveyed women by individual cities within the respective groups.

Percentage married—cities 100,000-500,000 population.

Geographic Area	Total 15–44		15–19		20–24		25–34		35–44	
	Survey	Census	Survey	Census	Survey	Census	Survey	Census	Survey	Census
East	51.8	56.2	3.5	6.0	32.9	39.5	68.1	73.8	76.5	79.6
Central	55.6	57.5	6.6	9.1	39.4	43.0	69.9	71.8	75.9	76.7
South	59.4	60.4	11.6	13.8	47.6	51.8	71.9	75.1	75.5	75.7
Mountain	57.4	58.1	7.9	9.0	45.9	47.0	76.7	77.7	79.7	80.7
Pacific	59.1	60.1	6.1	8.7	44.7	46.3	73.6	74.6	78.4	78.4

[18] In a recent study based upon English materials, Tietze essayed to solve some of this difficulty by computing paternity rates according to occupational status of males. That is, he related births not to females but to males, using single as well as married men in the base populations. Of course, this procedure did not remove the factor of possible shifts in occupational status during the reproductive period. *See* Tietze, Christopher: Differential Reproduction in England. The Milbank Memorial Fund *Quarterly*, July, 1939, xvii, No. 3, pp. 288-293.

itself. Unless such conditions are met, part of the derived class differences in fertility may be of spurious nature, arising from undue selections in proportions married.

From theoretical considerations it would appear that a classification based upon family income does not meet the above conditions. As previously defined, "family income" relates to income of the head of the household and of resident persons related to the head by blood, marriage, or adoption. As used in individual cases, the attribute thus lacks uniformity of meaning and temporal stability. These deficiencies, of course, are present when the attribute is used for classifications of married women. When, for purposes of fertility analyses, the attribute is used for classification of females regardless of marital status, there would appear the possibility of an additional type of bias accruing from an unwarranted selection of unmarried (and therefore infertile) females into upper income brackets. Several factors would seem to lead toward this result. In the first place, there is the possibility of a "forced" selection of unmarried females into higher income categories simply by virtue of the greater likelihood that unmarried females 15-44 are gainfully employed and thus supplement the earnings of the household head. Even in cases where the family income represents the earnings of only one person, it is possible that the selective factors operate in the same direction in so far as females in the youngest age groups are concerned. In such cases the status of the unmarried female is likely to be determined by earnings of a middle-aged father, while that of the young married woman may depend upon earnings of a young husband who is just beginning his employment career.

There are, of course, situations serving to offset in some degree the biasing factors described above. The recorded status of the wife, like that of unmarried daughters, may be raised by multiple gainful employees within the household.[14] Furthermore, unmarried wo-

[14] There are, however, increased chances that the wife is 45 years of age and over and therefore not included in the tabulations if the household includes gainfully employed offspring.

men living alone and those coded as "heads" in abnormal (partner) households were classified according to their personal incomes.[15] Whatever may be the net effect of possible biases accruing from the income classification, they should be kept in mind in considering the results presented.

Since it is not possible to test directly the importance of the above limitations, it is fortunate that similar analyses of fertility differentials could be made on the basis of educational status of females 15-44 years of age.[16] "Educational attainment" is a highly personal attribute possessing uniformity of meaning when applied to unmarried and married females. It is not subject to immediate change in the event of marriage *per se*. Furthermore, its generally stable character would appear to give it better suitability for use in con-

[15] It should be stated, however, that enumerated persons unrelated to household heads were deliberately consigned to the "unknown income" category in order to prevent their classification according to income status of the families with whom they resided in the capacity of roomers, servants living in, etc. The original coding procedure was to assign these persons to the income group corresponding to that of the family with whom they lived. The original type of classification was found to be of minor consequence in so far as nuptial rates are concerned because such unrelated persons constituted a negligible proportion of the married white females 15-44 years of age. For all other fertility rates by income status, it was found desirable deliberately to relegate unrelated persons to the "unknown income" category. This appeared especially wise in so far as resident servants were concerned. Since these were mainly unmarried and attached to families earning $3,000 and over, their inclusion would have lowered unduly the fertility rates of the higher income group. Of the 9,000 female servants 15-44 years of age, about 60 per cent were employed by families earning $3,000 and over. It would have been preferable to have the actual income status of unrelated members of households, but in view of the above situation, exclusion seemed preferable to retention in specific family income classes. It should be emphasized that unrelated persons were not excluded from the base populations when the rates pertained to all incomes, and it should also be emphasized that unrelated persons were included and classified in their own right on the basis of educational attainment.

[16] It should be stated that although they are designed to relate to the total surveyed urban white female population 15-44 years of age, the general fertility and gross and net reproduction rates according to educational status were derived in part on a sampling basis. The numbers of white births by age and educational status of the mother were available from tabulations of the complete data that had been made for computation of nuptial fertility rates. Due to the absence of cross classification by education and age (in five-year groups) for all urban white females 15-44 years of age in the total survey, however, the base populations were secured from tabulations of a 0.5 per cent random sample of the punch cards which had previously been mechanically established for sundry uses in connection with analyses of *Health Survey* data. This established sample has been tested by machining items which were tabulated in full. The derived number of women by five-year age groups in each of the four broad educational classes of this sample was multiplied by 200, and the resulting numbers were related to the actual corresponding distribution of births for the computation of rates.

nection with reproduction rates than is afforded by an index based upon family income. This latter point will be discussed in a later section but suffice it to say here that the differentials in general fertility and reproduction by income status may perhaps be better evaluated by comparison with corresponding analyses based upon educational attainment.

ANALYSIS OF THE DATA

Crude Birth Rates. Before considering refined fertility rates based upon female populations of childbearing age, it may be of interest to observe the character of crude birth rates per 1,000 total surveyed urban population in the various family income classes. These rates

Table 1. Crude birth rates, standardized general and nuptial fertility rates, and gross and net reproduction rates in 1935 among the white urban populations in the National Health Survey, by socio-economic classes.[1]

Socio-Economic Class	Crude Birth Rates	Standardized Fertility Rates[2]		Reproduction Rates	
		Nuptial	General	Gross	Net[3]
(1)	(2)	(3)	(4)	(5)	(6)
Annual Family Income					
$3,000 and Over	7.8	84.6	31.1	.46	.42
$2,000–$2,999	10.4	84.8	41.6	.61	.55
$1,500–$1,999	12.8	93.0	48.4	.70	.63
$1,000–$1,499	15.8	102.5	60.5	.86	.75
Under $1,000 (Relief and Non-relief)	17.3	132.9	82.1	1.17	.96
Under $1,000 (Nonrelief)	*13.5*	*110.1*	*66.1*	*.93*	*.79*
On Relief	*19.6*	*166.3*	*99.4*	*1.43*	*1.15*
Educational Attainment					
College	—	96.9	39.1	.57	.52
High School	—	102.5	53.7	.77	.68
7th or 8th Grade	—	117.5	71.0	1.00	.86
Under 7th Grade	—	130.7	82.9	1.18	.97
Total Population	13.8	108.9	56.8	.81	.70

[1] Based on data from the National Health Survey, conducted by the United States Public Health Service, 1935–1936. All rates were adjusted according to the distribution of the urban population in the United States by geographic region and size of city, as in the 1930 Census.

[2] The nuptial fertility rates were standardized for age on the basis of the white married female population (15–44) in the United States, 1930, and the corresponding total female population (15–44) was used for standardizing the general fertility rates.

[3] Differential mortality rates used for computing net reproduction rates by economic class were based on Hauser's data for Chicago (*see* footnote 24).

(Table 1, Column 2) ranged from 7.8 for populations in family income classes of "$3,000 and over," to 17.3 for all in the "under $1,000" group (regardless of relief status), and to 19.6 for the relief group considered separately.[17]

Crude birth rates, of course, are not only influenced by proportions married but also by factors such as age-composition and sex ratios. As presented here, however, they serve to give some indication of the character of differentials in birth rates by income[18] when the total white urban population is used as the base and when all variables, as actually found in such populations, are allowed to operate. Such data are rarely found in the literature on differential fertility, and it is mainly for this reason that they have been included in this report.

Nuptial Fertility Rates. As previously mentioned, former fertility studies based upon data from the present *Survey* have been confined to married women. These have suggested that in so far as *marital* fertility is concerned there may be some departure from the traditional inverse association between fertility and socio-economic status. An outstanding aspect of this situation is summarized in Figure 1 (based on Table 1, Column 3) which pertains to standardized nuptial fertility rates of surveyed urban white wives according to family income and educational status. Although the general picture is one of inverse association between nuptial fertility and amount of family income, it is seen that the average fertility rates were about the same for wives reporting family incomes of "$3,000 and over" and for those reporting "$2,000-$2,999."[19] On a straight

[17] The reader is cautioned against attributing excessive fertility among relief recipients to the extension of relief itself. A selective factor is doubtless inherent in the greater tendency of welfare organizations to grant assistance to families with infants or expectant mothers than to other indigent families.

[18] Tabulations were not made to permit the computation of crude birth rates according to educational status.

[19] This situation is consistent with what has been reported in a previous analysis for *native* white wives in combined areas of the *Survey*. Subdivisions of those data by area and size of community, however, indicated that in some area-size groups nuptial fertility rates

(Continued on page 378)

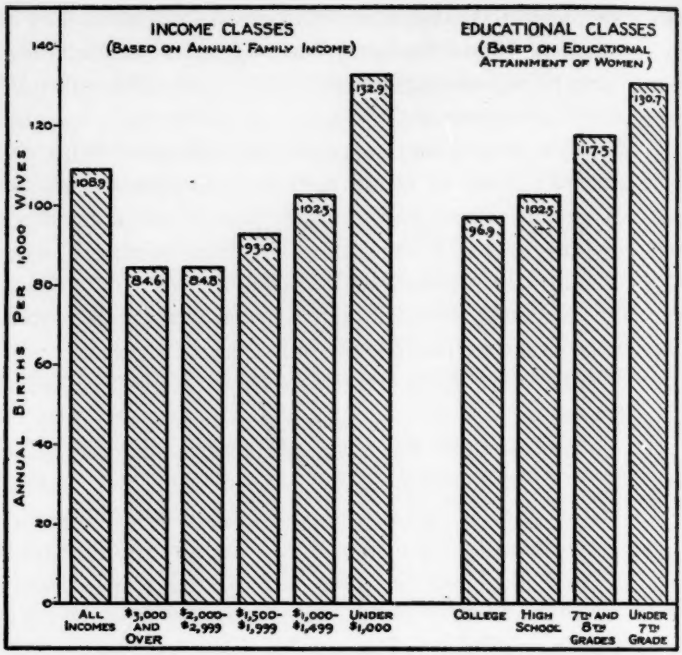


Fig. 1. Standardized nuptial fertility rates for 1935 among white urban wives of childbearing age, in the National Health Survey, by family income and educational status. (From Table 1, Column 3.)

income basis, the widest disparity in fertility of wives in successive income classes was that observed between the "under $1,000" and "$1,000-$1,499" groups. Class variations in fertility appeared to be of relatively small import above the $2,000 income level.

were in some instances higher and sometimes lower among native-white wives reporting family incomes of "$3,000 and over" than for those reporting $2,000-$2,999. The data for all urban native-white wives classified by educational status also indicated a pattern of differentials in nuptial fertility similar to that observed in the present analysis for the urban white married women regardless of nativity. When the native-white wives were classified according to occupational status of the head, the average urban fertility rate for wives of professional men was somewhat higher than for wives of business men. The point to be emphasized here, however, is that the inclusion of foreign wives in the present total urban white sample did not substantially alter the character of variations in nuptial fertility according to income or educational status.

See Kiser, C. V., *op cit*, pp. 136-138.

Essentially the same type of situation is true of nuptial fertility rates according to education of the married women. After differences in age-composition were standardized, the fertility rate for college wives was only a little below that for wives reporting high school status. It is well known, however, that whatever may be the fertility rates of college women who marry, marriages are later and less frequent among college women than in the general population.[20] The effect of class differentials in marriage frequencies at different ages is given full play in the general fertility rates and in gross and net reproduction rates presented in the following pages.

Standardized General Fertility Rates. Our attention is turned now to the character of differential fertility by income and educational classes when the data relate to all surveyed urban white females of childbearing age, married and unmarried combined. The standardized general fertility rates (Table 1, Column 4) represent the average number of births during one year per 1,000 surveyed females 15-44 years of age, grouped according to family income status and according to educational attainment of the women. It is readily apparent that when the analysis is not restricted to married women, the traditional inverse association between fertility and income status is sharply manifested. Attention is directed especially to the consistent extension of this type of relation into the upper income categories. In contrast to the equality of nuptial fertility rates for married women in the two highest income classes, the general fertility rate for the "$2,000-$2,999" group was about 34 per cent higher than that for the "$3,000 and over" group.

A consistently sharp inverse association is also found in the standardized general fertility rates for women classified according to educational attainment. The rate for women reporting less than seventh grade formal education was a little over twice as high as that for women reporting college attendance, and the rate for wo-

[20] For studies bearing on this point, *see* Lorimer, F. and Osborn, F.: DYNAMICS OF POPULATION. New York, The Macmillan Company, 1934, pp. 320-325.

men of high school status surpassed that for college women by 37 per cent. When the analysis was confined to married women (nuptial fertility rates), it was found that the rate for wives of high school rank was only 6 per cent higher than that for married women of college attainment. Thus, when the influence of class differences in proportions married is brought into the picture, no exception is found to the inverse order of income and educational classes with respect to fertility.

Gross Reproduction Rate. Despite differences in base populations, all three types of rates presented in foregoing pages are annual rates. In order named, the crude birth rates, the nuptial fertility and general fertility rates represent average number of live births during one year per 1,000 total population, per 1,000 married women 15-44 years of age, and per 1,000 females of childbearing age regardless of marital status. A different concept is introduced by the gross reproduction rate, although this index is derived from the basic age-specific fertility data needed for computing the standardized general fertility rate discussed above. As stated before, this rate is designed to represent the average number of *daughters* that would be borne throughout the entire childbearing period among a cohort of females starting life together, under the assumption that existing levels of age-specific fertilities will prevail and under the further assumption that all such women survive the complete childbearing span.[21] The assumption that each female will live through the complete childbearing age is unwarranted, but the gross reproduction rate is merely a device to portray the fertility of the group apart from mortality. The age-specific mortalities are taken into account in the net reproduction rates to be considered in later pages. It is, of course, also unlikely that existing age-specific fertilities will persist

[21] The rate is computed by the simple addition of age-specific birth rates of females irrespective of marital status, the sum multiplied by five if quinquennial age groups are used. In this study the resulting sum was reduced to represent average number of daughters (instead of births) *per individual female*. The assumed sex ratio at birth was 1,058 males per 1,000 females.

throughout the oncoming generation, but a similar type of assumption with reference to mortality is conventionally made in the construction of life tables.

To some degree the lack of rigidity of socio-economic groups must be taken into account in any type of analysis of class differences in fertility. The factor possibly has special relevance to reproduction rates[23] based on such attributes as occupational status, amount paid for rent,[24] or family income. Since such rates are derived by addition of age-specific fertility rates for all females in a given class, there is the postulate of stability of rank during the childbearing period. Actually, no such stability exists. On the other hand, the upward and downward shifts may be mutually compensatory, at least in part. Whatever the net result of shifts in economic status may be, the educational attainment of adults is a more stable attribute, and analyses based thereon should provide some check on those based upon family income.

The above conditions must be kept in mind in interpreting the reproduction rates. It must be emphasized that these rates are designed simply to give a more or less general portrayal of reproductivity in the various socio-economic groups *on the basis of existing age-specific fertility levels.* The age-specific fertilities of the surveyed urban white females in families reporting under $1,000 income were such as to yield a gross reproduction rate of 1.17. This may be interpreted to mean that 1,000 females starting life together in this class would bear 1,170 daughters (or an average of 1.17 per woman) if existing age-specific fertilities continue, if all females survive the childbearing period and remain in the "under $1,000" income class during the childbearing period. The corresponding rate for women

[23] Changes of socio-economic status are also specially relevant to studies of differential fertility when the index of fertility pertains to past histories of births (such as total number of children ever born and to less extent to children under 5) instead of simply expressing average number of births during one year.

[24] For references to analyses of reproduction rates according to occupational status and rentals, *see* footnotes 13 and 24 respectively.

in the "$3,000 and over" income group was 0.46, less than half as high as that for the "under $1,000" group.

Since the basic materials for the gross reproduction rates and for standardized general fertility rates are identical (being age-specific birth rates during 1935 for females 15-44 regardless of marital status) it is natural that the pattern of class differences in gross reproductivity is of similar character to class differences in general fertility rates. In Table 1 (Column 5) there is complete accordance with the traditional inverse relation of fertility and socio-economic status. There were consistent and well-defined differences between the rates for successive income classes, and these extend into the higher income groups. The rate for females classed in the $2,000-$2,999 category was about 33 per cent higher than for females reporting family incomes of $3,000 and over.

The gross reproduction rates of the population differentiated by educational classes (Table 1, Column 5) were computed as 1.18, 1.00, 0.77, and 0.57 for females reporting educational attainment under seventh grade, seventh-eighth grades, high school, and college, respectively. The fertility, thus expressed, of the females with less than seventh grade education was about 53 per cent higher than that for high school women, and was 107 per cent higher than the fertility of women with college education. The fertility of women with high school education exceeded that of women with college education by some 35 per cent. In the analysis confined to married women, the rate for high school wives was only about 6 per cent higher than that for college wives.

In Table 2 (top section), the gross reproduction rates according to income are presented for cities grouped according to size. A consistent decline of the rates with increasing income is uniformly found regardless of size of city. Attention is directed to the inverse relation between gross reproduction rates and size of city, no matter which income group is considered. This situation has been found in other studies and may perhaps be partially explained by a nearer

Size of City	Annual Family Income							
	All Incomes	$3,000 & Over	$2,000–$2,999	$1,500–$1,999	$1,000–$1,499	Under $1,000		
						Total	On Relief	Non-relief
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Gross Reproduction Rates								
Cities with Populations:								
100,000 and Over	.73	.42	.53	.67	.81	1.03	1.27	.85
25,000–99,999	.88	.48	.66	.68	.85	1.23	1.55	.98
Under 25,000	.92	.52	.71	.78	.96	1.31	1.64	1.05
All Cities	.81	.46	.61	.70	.86	1.17	1.43	.93
Net Reproduction Rates[2]								
Cities with Populations:								
100,000 and Over	.63	.38	.48	.59	.71	.85	1.02	.72
25,000–99,999	.75	.44	.60	.61	.74	1.01	1.25	.83
Under 25,000	.79	.47	.65	.70	.84	1.08	1.32	.89
All Cities	.70	.42	.55	.63	.75	.96	1.15	.79

[1] The rates for groups of cities by size were adjusted to the distribution, by area of the 1930 Census populations in all cities of respective size.
[2] *See* Table 1, footnote 3.

Table 2. Gross and net reproduction rates of the surveyed white urban populations in the United States by income and size of city, 1935.[1]

approach to the rural way of life in smaller cities. It is possible, too, that a selective process of migration from rural areas to smaller cities is directly involved.

Net Reproduction Rates. As stated above, the net reproduction rates are derived by reducing the specific fertility rates according to the prevailing age-specific mortality rates for the group considered. Thus a net reproduction rate of 1.5 means that at existing age-specific fertility *and mortality*[24] rates, a cohort of 1,000 females start-

[24] The differential mortality rates, used in computing the net reproduction rates for various classes, were adapted from Hauser's data for Chicago Census tracts, grouped according to median rentals. *See* Hauser, P. M.: Differential Fertility, Mortality, and Net Reproduction in Chicago, 1930. Table 20. (Unpublished doctoral dissertation, University of Chicago, 1938.)

Note: The above is a careful study which has the advantage of being based on birth registration for an entire large city. It should be realized, however, that as in other studies based upon official data, the unit of classification was not rent paid by the individual family but the median rental for the Census tract in which the individual lived.

ing life together would bear a total of 1,500 daughters (or an average of 1.5 per woman). With such a rate, the ratio of the present generation to the following one would be 1.0: 1.5. A net reproduction rate of 1.0 signifies that the rate is just sufficient to keep the population from ultimate decline. A rate of 0.75 means a potentially decreasing population, the ratio of the present to the next generation being 1.0:0.75. The net reproduction consequently indicates, in the above sense, the potential rate of increase or decrease per generation.

The net reproduction rate for the entire urban white surveyed females, regardless of income status, was found to be 0.70. The rate by size of community was 0.63 in cities of over 100,000 population, 0.75 in cities of 25,000-100,000 population, and 0.79 in cities with fewer than 25,000 inhabitants (Table 2). These rates are significantly lower[25] than those derived from official data for 1930. This is doubtless accounted for in part by declines in urban fertility during the period 1930-1935, but it should also be emphasized as indicated above, that there was possibly some underenumeration of births by the *Survey* in certain areas.[26] Some caution should therefore be used in the interpretation of absolute heights of the various rates. For instance, it is likely that the average net reproduction rate for the "under $1,000" group should be somewhat above instead of just under the requirements for population replacement. (Figure 2; Table 1, Column 6.) The same is probably true in regard to the net reproduction rate for the "under seventh grade" group. It seems improbable, however, that underenumeration of births was great

[25] By way of comparison it may be stated that analyses based upon official data for 1930 indicated a net reproduction rate of 0.84 for the total white urban population; 0.76 for cities of 100,000 or more population; 0.86 for cities of 25,000-100,000 persons; and a rate of 0.94 for cities with fewer than 25,000 inhabitants. *See* Karpinos, Bernard D.: The Differential True Rates of Growth of the White Population in the United States and Their Probable Effects on the General Growth of the Population. *The American Journal of Sociology*, September, 1938, xliv, pp. 251-273.

[26] Another factor which should be mentioned is that the *Survey* was somewhat overloaded with large cities. The procedure of weighting rates according to distribution of the urban population by size of city may not have wholly eliminated the influence of this factor because the size groups are broad.

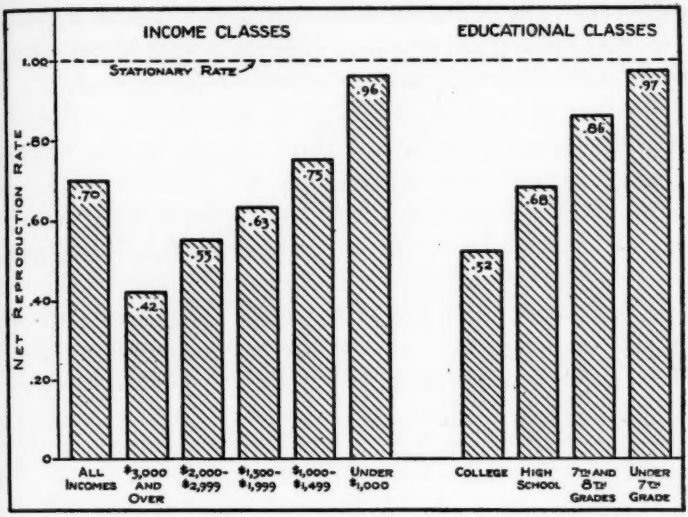


Fig. 2. Net reproduction rates of the white urban populations in the National Health Survey, by family income and educational status, 1935. (From Table 1, Column 6.)

enough to move any of the remaining rates from below to above unity. In other words, urban white women in families with incomes as high as $1,000 and those with as much as seventh or eighth grade schooling, were characterized by average net reproduction rates too low for permanent renewals of their population.

The net reproduction rates exhibit a consistent inverse relationship between fertility and socio-economic status. The inter-class divergencies of the net rates are not so sharp as those of the gross rates, due to the relatively lower mortality rates assumed for the upper income groups. Nevertheless, the range extended from 0.42 in the income group of "$3,000 and over" to 0.96 for the "under $1,000" group. The rate for females in the "$2,000-$2,999" group was about 31 per cent higher than that observed for women in families reporting family incomes of $3,000 and more.

As classified by educational status, the net reproduction rates ex-

tended from 0.52 for college women to 0.97 for women reporting less than seventh grade schooling. The rate for high school women (0.68) surpassed that for college women by about 31 per cent.

It is therefore apparent that when indices of fertility are related to the total female population, there is consistency in the pattern of inverse association between fertility and socio-economic status. Not only is this true, but the relative spread of the rates is wider between extreme and successive income or educational groups than is found when the factor of marriage frequencies is held constant. This fact is explicitly demonstrated in Table 3 and Figure 3 where rates for each income and educational group are expressed as percentages of the corresponding type of rate for the total populations involved.[27]

Table 3. Relative ratios of the various indices of fertility for specific socio-economic classes to the corresponding rate for all socio-economic classes of respective urban white populations involved.[1] Rate for all classes expressed as 100.

Socio-Economic Class	Crude Birth Rates	Standardized Fertility Rates		Reproduction Rates	
		Nuptial	General	Gross	Net
(1)	(2)	(3)	(4)	(5)	(6)
Annual Family Income					
$3,000 and Over	54	79	55	57	60
$2,000–$2,999	72	79	73	75	79
$1,500–$1,999	89	87	85	86	90
$1,000–$1,499	110	95	107	106	107
Under $1,000 (Relief and Non-relief)	120	124	145	144	137
Under $1,000 (Nonrelief)	*108*	*102*	*116*	*115*	*113*
On Relief	*136*	*153*	*175*	*177*	*164*
Educational Attainment					
College	—	90	69	70	74
High School	—	95	95	95	97
7th or 8th Grade	—	109	125	123	123
Under 7th Grade	—	121	146	146	139
Total Population	100	100	100	100	100

[1] Derived from Table 1; *see* also footnote 27.

[27] For the above purpose, however, the crude and nuptial fertility rates for the base populations were adjusted according to the distribution of females 15-44 years of age, by income and by education. This was done in order to prevent unequal influence of class composition on the various base rates. The adjusted crude birth rate was 14.4; the adjusted nuptial rate for analysis by income was 107.4; and for analysis by educational status, 108.0.

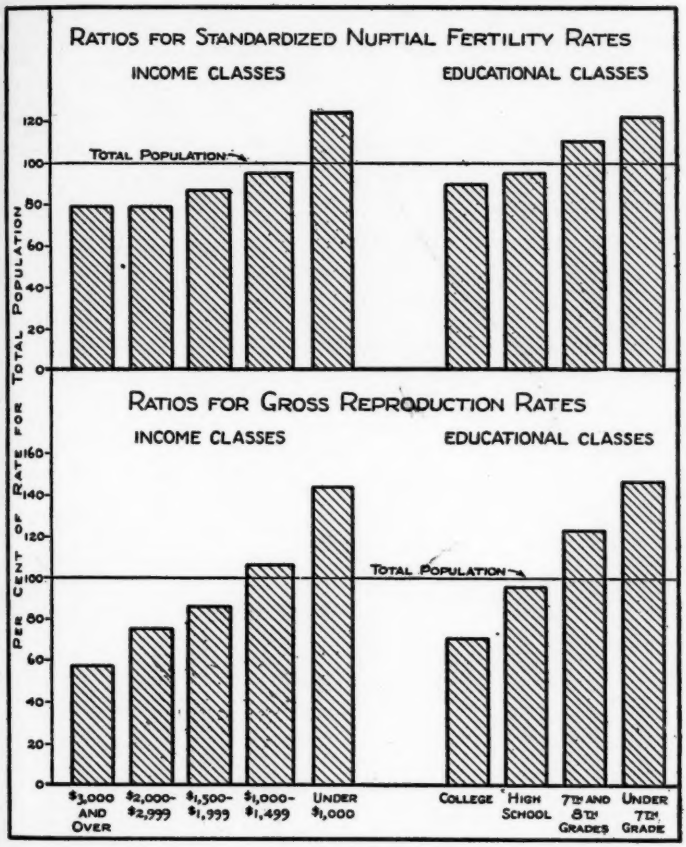


Fig. 3. Chart showing inter-class divergence of fertility rates restricted to married women 15-44 (top section of chart) in comparison with the inter-class spread of gross reproduction rates (based upon total females 15-44, lower section of chart). In each case the rate for all classes is expressed as 100. (From Table 3, Columns 3 and 5.)

It is seen, for instance, that when the analysis is restricted to married women (nuptial fertility rates), the rate for the "under $1,000" group is 24 per cent higher than the corresponding rate for all incomes. Comparable excesses were 44 per cent and 37 per cent for

Socio-Economic Class	Age of Women at Enumeration					
	15–19	20–24	25–29	30–34	35–39	40–44
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Annual Family Income[1]						
$3,000 and Over	1.7	15.3	42.9	63.4	74.2	77.0
$2,000–$2,999	2.4	25.4	60.1	75.9	80.5	82.8
$1,500–$1,999	3.6	35.0	68.2	79.6	83.0	82.8
$1,000–$1,499	5.9	48.0	73.6	80.7	82.1	80.1
Under $1,000 (Relief and Non-relief)	9.6	48.8	70.9	75.9	74.6	72.6
Under $1,000 (Nonrelief)	*11.5*	*49.6*	*69.1*	*73.8*	*72.5*	*70.1*
On Relief	*7.8*	*47.5*	*73.8*	*78.9*	*77.5*	*76.2*
Educational Attainment[2]						
College	2.0	22.7	55.8	60.0	80.6	79.0
High School	5.9	41.9	65.1	81.5	79.3	82.6
7th or 8th Grade	12.2	50.1	76.9	74.2	75.0	76.7
Under 7th Grade	15.6	50.6	72.6	90.7	80.9	72.3

[1] Proportions married by income status, based on the *Survey* for a group of cities described in footnote 28. Includes all in the household, regardless of relationship to household head.

[2] Proportions married by educational status, based on data for all cities included in the *Survey*.

Table 4. Proportions married among surveyed urban white females, by age, family income, and educational attainment.

gross and net reproduction rates, respectively. Similarly, the nuptial fertility rate for the "$3,000 and over" income group was 21 per cent lower than the average corresponding rate for all incomes, but the gross reproduction and net reproduction rates for this income group were, respectively, 43 and 40 per cent lower than such rates for the total incomes. Essentially the same situation is found in comparing the spread of the rates according to educational status when the analysis is and is not restricted to married women. Differentials in fertility are strikingly magnified by introduction of the influence of variations in proportions married.

The actual variations in proportions married in the different socio-economic classes are of interest in themselves. These data are presented in Table 4 by family income for a group of cities[28] com-

[28] The restriction to partial areas for the above analysis by income was made in order to show proportions married by five-year age intervals throughout the entire childbearing span. Only for the cities represented did the Health Survey tabulate the general female population 15-44 by quinquennial age groups classified by family income. The areas included above are mainly large cities in the Eastern, Central, and Southern regions.

prising 76 per cent of all surveyed urban white females 15-44 years of age, and by educational status for urban white women of childbearing age in the total *Survey*. The tendency for proportions married to vary inversely with income and educational status is manifested fairly consistently for ages under 35.[79] At ages 15-19, approximately 10 per cent of females reporting family incomes of under $1,000 were married as compared with less than 2 per cent of those reporting family incomes of $3,000 and over. Corresponding percentages were 49 and 15 at ages 20-24; and 71 and 43 at ages 25-29. Similarly, about 16 per cent of the females 15-19 reporting under seventh grade schooling were married as compared with 2 per cent of those of the same ages reporting some college attendance. Corresponding percentages were 51 and 23 at ages 20-24, and 73 and 56 at ages 25-29. Special attention is called to the striking differences between the two groups ranking highest with respect to income and educational status. For instance, at ages 20-24, 25 per cent of the females reporting family incomes of $2,000-$2,999 were married as compared with only 15 per cent of those in the "$3,000 and over" group. The proportion married among females 20-24 reporting high school training was almost twice as great as that for college women of identical ages. The latter situations, of course, are basic to the wider discrepancy in fertility of these groups when the index is based upon total female populations instead of married women. The effect of variations in proportions married on the pattern of differential fertility is not confined, of course, to socio-economic groupings. It is found in considering fertility differentials by rural-urban residence, and also in comparing separate states, especially northern states with southern states.[80]

[79] The failure of this association in the age groups 35-39 and 40-44 may be due in part to the fact that widows, divorcees, and women permanently separated from former husbands are not included as "married." The analysis pertains not to proportions "ever married" but to those "married" on the day of the enumeration.

[80] This problem is discussed by B. D. Karpinos in a forthcoming paper "The Concept of Fertility and its Implications."

CONCLUSIONS

The broad implications of this paper may be summarized as follows:

1. Although recent studies have provided suggestive evidence of a diminishing importance of class differences in the fertility of urban white *married women,* the traditional inverse relation between fertility and socio-economic status is found still to be consistently and sharply manifested when the analysis embraces *all* urban white women of childbearing age.

2. The above situation is due to the fact that there is a sharp inverse association between *proportions married* and socio-economic status, especially when younger ages are considered.

3. The average net reproduction rate for the surveyed urban white females was 0.70, the range extending from 0.42 for females reporting family incomes of $3,000 and over to 0.96 for all in the "under $1,000" income group; and from 0.52 for women reporting college attendance to 0.97 for those who attained less than seventh grade status. Although the absolute height of these figures cannot be interpreted too closely, they afford indications of the very low reproductivity of the groups ranking highest in socio-economic status. The average net reproduction rates for urban white groups, least privileged with reference to income and educational ranking, were, on the other hand, at or above the levels required for permanent population replacement.

4. One cannot state, of course, that the restriction or non-restriction to married women is universally the preferable procedure in studies of differential fertility. Both approaches are important and, although they serve different purposes, both are needed for proper interpretation of trends in group differences in fertility. The confining of such analyses to married women serves to hold constant the factor of variation in proportions married and permits a better understanding of what is taking place in group differentials in the

fertility of married women. On the other hand, the computation of reproduction rates requires the inclusion of unmarried women, for the potential rate of growth of a population depends upon frequency of marriage at different ages as well as marital fertility. Thus, if there is undue neglect of the rôle of differences in proportions married, there is danger that results based exclusively upon married women will be misinterpreted. The data presented in this report clearly show that approximate equality of the fertility rates for *married* women in the two upper income groups and in the two upper educational groups must not be interpreted as indicative of equality in potential rates of growth. The reproductivity of females reporting family incomes of $3,000 and over was a good deal lower than that for comparable women reporting $2,000-$2,999; and that of college women was significantly lower than that of women of high school status.

BIRTH CONTROL IN A MIDWESTERN CITY

A STUDY OF THE CLINICS OF THE CINCINNATI COMMITTEE ON MATERNAL HEALTH

REGINE K. STIX, M.D.[1]

III. AN APPRAISAL OF CLINIC SERVICE[2]

INTRODUCTION

THE primary function of the maternal health clinic is to advise its patients how to prevent pregnancy when, for reasons of health, pregnancy is contraindicated. Since accidental pregnancy may seriously affect the health of the patient, clinic policies must be directed toward providing each patient with a contraceptive that is both acceptable to her and effective for her.

In most birth control clinics in the United States the occlusive vaginal diaphragm with a spermicidal jelly has been the contraceptive method of choice. Clinic experience has shown this to be a highly effective type of contraception when used with approved techniques. For the woman who could not be fitted with a diaphragm the usual alternative has been a feminine contraceptive method such as cervical cap or jelly alone, which afforded as nearly as possible the same type of protection as the diaphragm and jelly.

In the years 1930-1934 the clinics of the Cincinnati Committee on Maternal Health prescribed diaphragm and jelly for all of their patients who could possibly be fitted with diaphragms. For the 2 per cent who could not be fitted with diaphragms, they prescribed spermicidal jelly alone.[3]

[1] From the Milbank Memorial Fund.

[2] The first article in this series: I. "Contraception and Fertility Before Clinic Attendance," was published in the Milbank Memorial Fund *Quarterly*, January, 1939, xvii, No. 1; the second article: II. "The Effectiveness of Contraception After Clinic Attendance," in the April, 1939, *Quarterly*, xvii, No. 2.

[3] The proportion of patients fitted with diaphragms was higher in these clinics than in some other clinics. The proportions given diaphragms in other clinics, for which figures are available, varied between 80 and 99 per cent of the patients prescribed for.

The Cincinnati clinics are organized to give each patient as much time and service as is necessary to insure complete understanding of the technique of use of the single method prescribed. A careful history is taken when the patient first attends the clinic; she is examined, fitted, and instructed in the use of the diaphragm by a physician, and then given supplementary instruction by a trained nurse. She is requested to return within a week so that her technique of use may be checked by the examining physician. If the technique is difficult to master, she is encouraged to return as often as is necessary until she is sure of it. Each patient is expected to return every six months for reexamination by the physician, and for recheck on her technique of use of the diaphragm.

Such intensive care should insure the best use of the prescribed contraceptives and should encourage the confidence of the patient in them, but, in spite of the encouragement and help given, a substantial proportion of the women interviewed, in the study conducted by the Milbank Memorial Fund, had given up the use of the diaphragm and jelly by the time they were followed up.

The loss of a large number of patients, in spite of a well-conducted clinic organization with service at little or no cost to the patient, suggests the need for changes in clinic policy. However, if changes in policy are to be made, they must be preceded by detailed study of the factors involved in the loss of patients and careful evaluation of the suitability of the type of contraception prescribed, for couples with differing fertility and different social and economic backgrounds.

THE ACCEPTABILITY OF THE DIAPHRAGM AND JELLY[4]

The suitability of a given contraceptive for a couple or for a group of couples depends on two factors: (1) its acceptability to the couple or to the group, and (2) its effectiveness when used by that couple

[4] In the subsequent discussion the term "diaphragm and jelly" will be used to cover all clinically prescribed contraceptives. The number of women for whom jelly alone was prescribed was too small to permit of separate classification.

or group. The evaluation of the acceptability of the contraceptives prescribed by a clinic has great significance for the formulation of clinic policy. The most effective contraceptive can be effective only for people who like it well enough to use it, and some other provision must be made for those who do not find it acceptable.

The proportion of couples in any large group who use the contraceptives prescribed for them for any given length of time is a measure of the acceptability of those contraceptives to the group. Three factors may affect the proportion of patients using the prescribed contraceptives: (1) the number of couples in the sample who gave them up because sterility or broken marriage ended their need for all contraception; (2) the number of couples who, though they still had occasion to use contraception, discarded the methods prescribed for them because of dissatisfaction with the contraceptives themselves; and (3) the length of time during which it was possible for each couple to use contraception, i.e., the number of elapsed months between the initial clinic contact and the follow-up interview during which the wife was exposed to the risk of pregnancy.

About 9 per cent of the patients who applied to the Cincinnati Maternal Health clinics for advice were widowed, divorced, separated from their husbands, sterilized, or in the menopause before they were interviewed. Of the patients who first came to the clinic in 1930, nearly 12 per cent were sterile or widowed before the end of the first year following their initial clinic visit.[5] The proportions of patients coming in the four later years, whose exposure ceased within twelve months of the initial contact, varied between 4 and 7 per cent. The exposure of an additional 2 to 4 per cent of patients was ended by sterility or broken marriage in the second year following their initial clinic contact.

[5] A large proportion of the first year's patients were relief recipients, referred because of illness of the wife or husband or because of too frequent pregnancies. In a number of instances the wife was a candidate for a sterilizing gynecological operation or the husband was fatally ill at the time of the first clinic contact.

Table 23 and Figure 9 show, for the patients attending the clinic for the first time in each of five years, the proportions who were using the prescribed contraceptives at the end of one month, three months, six months, and successive six-month intervals after their first contact with the clinic.[6] The proportions of women using the

Table 23. Proportion of women coming to the clinic in each of five years who were using the prescribed contraceptives at the end of each specified period following the initial contact with the clinic.

Number of Months Following Initial Clinic Contact	Year of First Contact				
	1930	1931	1932	1933	1934
	Number of women[1]				
	96	179	286	402	447
	Per cent using at end of each period				
1 Month	82.3	78.8	85.0	87.8	86.4
3 Months	74.0	67.0	79.0	84.3	82.1
6 Months	65.6	61.5	73.8	78.9	77.0
12 Months	52.1	52.5	63.3	70.9	66.7
18 Months	46.9	44.7	57.0	63.4	
24 Months	39.6	36.3	51.7		
30 Months	38.5	34.1	50.3		
36 Months	36.5	30.2			
42 Months	35.4	28.5			
48 Months	33.3				
54 Months	33.3				

[1] 1,410 cases. The following were excluded from the table: 146 cases who gave up the CIP because they were widowed, divorced, sterilized, or past the menopause and no longer needed a contraceptive; and 65 cases whose exposure to pregnancy subsequent to clinic contact was less than the longest period of use entered for that year's patients. These cases were distributed as follows:
1930: Eight cases whose total postclinic exposure to pregnancy was less than 54 months
1931: Fourteen cases whose total postclinic exposure to pregnancy was less than 42 months
1932: Seventeen cases whose total postclinic exposure to pregnancy was less than 30 months
1933: Eight cases whose total postclinic exposure to pregnancy was less than 18 months
1934: Eighteen cases whose total postclinic exposure to pregnancy was less than 12 months
The experience of women who used the CIP intermittently was entered as follows:
(a) Those whose use was intermittent because they were out of exposure because of pregnancy, abstinence, or separation, were entered as using the CIP over the whole period until they were interviewed or until they gave it up for another type of contraception; and
(b) Those whose use was intermittent because they used another type of contraception temporarily and then returned to CIP, were entered only for the first period of use of the CIP.
These adjustments are based on the position that women may be considered users of the prescribed contraceptives if they use them during all periods in which they are in need of contraception, and that they may be considered not to be users of the method prescribed after they once give up that method, even though they may subsequently return to it. Any bias inherent in one type of adjustment runs counter to that inherent in the other.

[6] All interviewed cases were included, except those who gave up contraception because they were sterilized, past the menopause, widowed, or separated from their husbands, and a few cases whose exposure to pregnancy subsequent to clinic contact was less than the

(Continued on page 396)

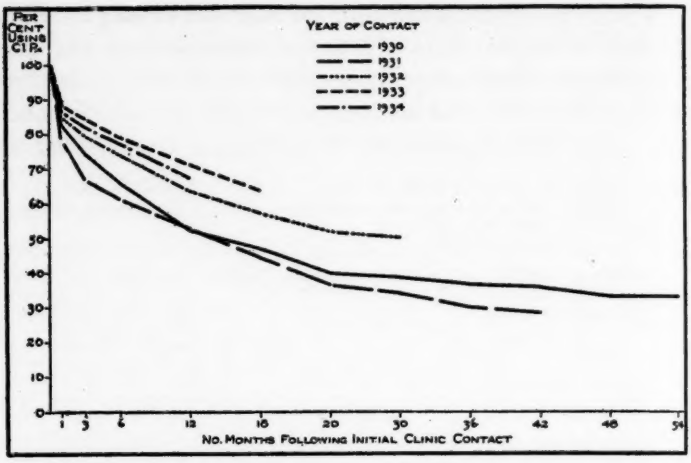


Fig. 9. Proportion of women coming to the clinic in each of five years who were using the prescribed contraceptives at the end of each specified period following the initial contact with the clinic.

diaphragm and jelly at the end of each period were higher among those who first came to the clinic in the years 1933 and 1934 than among those whose first clinic visits occurred in the three earlier years.[7] The most rapid loss of patients occurred within four months of the first clinic visit. Three months after the initial clinic contact between 67 and 85 per cent of the patients advised were still using the diaphragm and jelly, as prescribed at the clinic, and a year after the first visit between 52 and 71 per cent were using them.[8]

longest period of use entered for that year's patients (for example, patients registered in 1930 who were exposed to the risk of pregnancy for less than fifty-four months after they attended the clinic, and who could not, therefore, have used the prescribed contraceptives for as long as fifty-four months, even though they had used them during their entire post-clinic exposure to pregnancy).

[7] At least two factors probably were involved in this difference: (1) the proportion of indigent patients was high among those who first came in 1930 and declined consistently in each subsequent year; and (2) the establishment of new clinics in areas accessible to the more crowded sections of the City probably made it easier for women who came in 1933 and 1934 to maintain contact with the clinic.

[8] An additional 3 to 5 per cent of all patients were using part of the prescribed contraceptives or using them part of the time, in each period.

There was considerable improvement in clinic-patient cooperation in the first five years after the clinic was established. However, the loss of even 30 per cent of the patients still in need of contraception, within thirteen months of their first application for birth control advice, leads to the conclusion that there is opportunity for further improvement. Investigation of the characteristics of patients who continued to use the diaphragm and jelly, as compared with those of patients who discarded them, should reveal some of the underlying conditions associated with use or non-use of the prescribed contraceptives. Such information may serve as a basis for the formulation of new clinic policies.

Anatomical abnormalities affecting the fit of a diaphragm are frequently thought to influence the acceptability of that method. The occlusive vaginal diaphragm is thought to be best suited to the woman whose vaginal walls are firm and whose cervix is readily palpable. There may be difficulty in retaining a diaphragm when the vaginal walls are relaxed or when they are distorted by fecal impaction, and difficulty in placing it when the cervix is not readily accessible or when obesity or short fingers or arms prevent the pa-

Table 24. Proportion of women with and without anatomical abnormalities which might interfere with the fit or placing of a diaphragm for whom diaphragm was prescribed.

Type of Anatomical Abnormality	Number of Women	Per Cent Fitted With Diaphragm
All Women[1]	1,990	98.3
Women with No Anatomical Abnormalities	942	99.5
Women with One or More Pelvic Abnormalities	1,009	97.2
Cystocele and/or Rectocele	288	97.2
Fecal Impaction	61	100.0
Malposition of Uterus	456	98.7
More Than One Pelvic Abnormality	204	94.6
Women with Obesity, etc., with or without Pelvic Abnormalities	39	89.7

[1] All women who attended the clinic in the period studied, "lost" as well as interviewed cases, with the exception of 26 women for whom the type of prescription was unknown, and 7 women for whom no pelvic examination was noted.

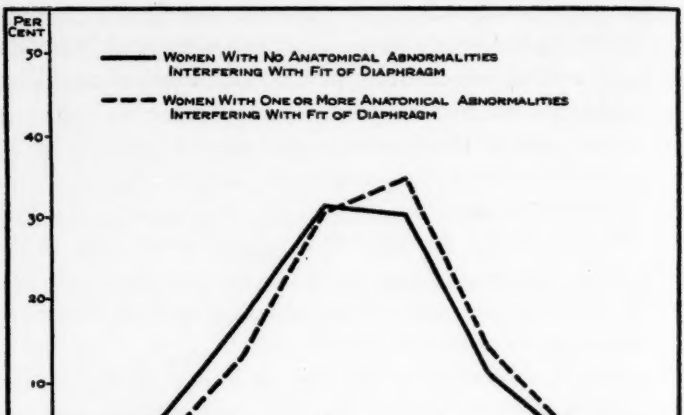


Fig. 10. Distribution of sizes of diaphragm prescribed for women with and without anatomical abnormalities which might have been expected to interfere with the fit of a diaphragm.

tient from feeling the cervix with ease.[9] More than half of the women who attended the Cincinnati Maternal Health clinics had one or more anatomical abnormalities which might have been expected to make the use of a diaphragm difficult, but 97 per cent of those who had such abnormalities were fitted with diaphragms (Table 24).

The sizes of diaphragm prescribed ranged from 55 to 100, with 75 and 80 the two sizes most frequently fitted. Women who had pelvic abnormalities were fitted with sizes larger than those prescribed for women who had none. The distribution of sizes prescribed for both groups is shown in Figure 10.

The proportion of women with anatomical abnormalities which might be expected to interfere with the fit or placing of a diaphragm,

[9] Dickinson, Robert L.: CONTROL OF CONCEPTION. Baltimore, The Williams and Wilkins Company, 1938, p. 179.

who discontinued the use of the prescribed contraceptives before the fourth month of use, was not significantly different from the proportion of those whose records showed no abnormalities (Table 25). About 66 per cent of women without abnormalities and the same proportion of women with malposition of the uterus, fecal impaction, or more than one pelvic factor used the diaphragm and jelly for thirteen months or more. Fifty-nine per cent of the women who might have been expected to have difficulty in placing a diaphragm and 62 per cent of those with relaxed vaginal walls used the prescribed contraceptives for more than a year.

The economic and social status of the patient, the amount of education she had had, the degree of crowding in the home, and the availability of private sanitary facilities were definitely associated with the acceptability of the diaphragm and jelly. All these factors were of course interrelated. Patients with little education came most

Table 25. Length of use of clinically prescribed contraceptives according to factors interfering with fit or placing of diaphragm.

Length of Use of CLB	Type of Anatomical Abnormality Interfering with Fit or Placing of Diaphragm				
	Total[1]	None	Malposition of Uterus, Fecal Impaction, or More Than One Pelvic Factor	Cystocele and/or Rectocele	Factors Other Than Pelvic[2]
	Number of Women				
	1,449[3]	681	536	198	32
	Per Cent Using CLB for Specified Number of Months				
Total	100.0	100.0	100.0	100.0	100.1
Used 3 Months or Less	20.0	19.2	20.5	21.2	18.8
Used 4-12 Months	14.6	15.0	12.9	17.2	21.9
Used 13 Months or More	65.4	65.8	66.6	61.6	59.4

[1] Exclusive of 146 women sterilized, widowed, divorced, etc., plus 26 with exposure to pregnancy less than 13 months. For all cases, excepting the 26 noted, thirteen months was the longest elapsed period between the initial clinic contact and the follow-up interview common to all patients. In this and subsequent tables relating to the length of use of the prescribed contraceptives, in which the experience of the patients coming to the clinic in all five years has been combined, all use of the clinic prescription for more than a year has been aggregated under the heading "Used 13 months or more."

[2] Women with obesity, short fingers, etc. A few had pelvic abnormalities also.

[3] Includes 2 women with unknown factors interfering with fit.

Length of Use of CLB	Number of Persons Per Room				
	Total[1]	Less Than 1 Person Per Room	1 or More Persons But Less Than 2	2 or More Persons But Less Than 3	3 or More Persons Per Room
	Number of Women				
	1,449[2]	217	739	374	101
	Per Cent Using CLB for Specified Number of Months				
Total	100.0	100.1	100.0	100.0	99.9
Used 3 Months or Less	20.0	15.7	18.0	24.1	26.7
Used 4-12 Months	14.6	12.0	13.4	15.5	27.7
Used 13 Months or More	65.4	72.4	68.6	60.4	45.5

[1] Exclusive of 146 women sterilized, widowed, divorced, etc., plus 26 with exposure to pregnancy less than 13 months.
[2] Includes 18 with unknown housing.

Table 26. Length of use of clinically prescribed contraceptives by housing.

frequently from indigent or low-income families living in crowded quarters. More than three-fourths of the patients who lived in crowded quarters had no access to a bathroom, and nearly half of them shared toilets or privies with other families.

The dominant factor associated with the acceptability of diaphragm and jelly was the degree of crowding in the home. Where crowding was excessive (three or more persons per room), 27 per cent of the patients gave up the diaphragm and jelly before they had used it for three months, and only about 45 per cent used it for more than a year. On the other hand, about 70 per cent of the patients who lived in houses in which there were less than two persons per room used the prescribed contraceptives for thirteen months or longer (Table 26).[20]

Both the degree of crowding and differences in social class were associated with acceptability (Table 27). As has been shown pre-

[20] The differences were as follows: Less than one person per room not significantly different from one or more persons but less than two: Difference = .038 ± .037.

One or more persons per room higher than two or more persons but less than three: Difference = .082 ± .030.

Two or more persons per room but less than three higher than three or more persons: Difference = .149 ± .053.

Length of Use of CLB	Total[1]	Couples Not on Relief		Couples on Relief
		White-Collar Workers	Manual Workers	
	TWO OR MORE PERSONS PER ROOM			
	NUMBER OF WOMEN			
	475	30	253	192
	PER CENT USING CLB FOR SPECIFIED NUMBER OF MONTHS			
Total	100.0	100.0	100.0	100.1
Used 3 Months or Less	24.6	33.3	21.7	27.1
Used 4-12 Months	18.1	—	19.8	18.8
Used 13 Months or More	57.3	66.7	58.5	54.2
	LESS THAN TWO PERSONS PER ROOM			
	NUMBER OF WOMEN			
	956	207	617	132
	PER CENT USING CLB FOR SPECIFIED NUMBER OF MONTHS			
Total	100.1	100.0	100.0	100.0
Used 3 Months or Less	17.5	13.0	18.0	22.0
Used 4-12 Months	13.1	11.6	13.0	15.9
Used 13 Months or More	69.5	75.4	69.0	62.1

[1] Exclusive of 146 women sterilized, widowed, divorced, etc., plus 26 with exposure to pregnancy less than 13 months.

Table 27. Length of use of clinically prescribed contraceptives by housing and social class.

viously,[21] the wives of white-collar workers found the diaphragm and jelly more acceptable than the wives of manual workers, and the wives of manual workers used them for longer periods than did the wives of relief recipients. In each social class the proportion of patients who continued to use the diaphragm and jelly for more than a year was between 8 and 10 per cent lower among those who lived in crowded quarters than among those who lived in homes in which there were less than two persons per room.[22]

[21] Table 17.

[22] Differences by housing and social class were as follows: Less than two persons per

(Continued on page 402)

Length of Use of CLR	Grade Completed				
	Total[1]	6th Grade or Less	7th or 8th Grade	1-3 Years High School	4 Years High School ± College
	Two or more persons per room				
	Number of women				
	475[2]	122	242	109	
	Per cent using CLR for specified number of months				
Total	100.0	100.0	100.0	100.0	
Used 3 Months or Less	24.6	30.3	21.9	23.9	
Used 4-12 Months	18.1	16.4	19.8	16.5	
Used 13 Months or More	57.3	53.3	58.3	59.6	
	Less than two persons per room				
	Number of women				
	956	120	386	297	153
	Per cent using CLR for specified number of months				
Total	100.1	100.0	99.9	100.0	100.0
Used 3 Months or Less	17.5	20.0	19.9	17.2	9.8
Used 4-12 Months	13.1	18.3	14.5	12.1	7.2
Used 13 Months or More	69.5	61.7	65.5	70.7	83.0

[1] Exclusive of 146 women sterilized, widowed, divorced, etc., plus 26 women with exposure to pregnancy less than 13 months.
[2] Total includes 2 women whose education was unknown.

Table 28. Length of use of clinically prescribed contraceptives by housing and education.

There was a direct association between the amount of education the patient had had and the length of use of the diaphragm and jelly, but when housing conditions were held constant (Table 28), it was found that, for women living in crowded homes, differences in education appeared to have little effect on the acceptability of the prescribed contraceptives. The proportions of patients who lived in the more crowded homes (two or more persons per room), who

room—white-collar workers higher than families on relief: Difference = .133 ± .051.

Manual workers—less than two persons per room higher than two or more persons per room: Difference = .105 ± .035.

All other differences were less than twice their standard error.

used the prescribed contraceptives for more than a year, varied from 53 per cent of those who had completed the sixth grade or less, to about 60 per cent of those who had gone to high school. On the other hand, among women who lived in homes in which there were less than two persons per room, 62 per cent of those who had had less than seven years of elementary education were using the diaphragm and jelly a year after they first attended the clinic and the proportions using increased with increasing education to 83 per cent of those who had completed high school.[18]

A complex contraceptive technique is especially difficult to use in a crowded home, where it is almost impossible to secure any degree of privacy. The fact that sanitary facilities in most of such homes are inadequate, only enhances that difficulty. Where crowding is less, other factors begin to have more weight. The woman with a high school or college education, who lives in a fairly comfortable home and has some privacy, is perhaps more willing than her less educated sister to assume the responsibility for a complex contraceptive, because she is confident that it will protect her against pregnancy when she wishes or needs to be protected.

In every group, however, some women gave up the prescribed contraceptives. Six hundred eighty-three women, or 46 per cent of those who were still exposed to the risk of pregnancy at the time of interview, had rejected the diaphragm and jelly before they were interviewed because they were dissatisfied with them as methods of contraception. The total was made up of different proportions of the three social class groups. It included 37 per cent of the wives of

[18] All differences between educational groups among women living in homes in which there were two or more persons per room were less than twice their standard error.

Among women living in homes in which there were less than two persons per room only the following difference was significant:

Women with four years of high school ± college higher than women with one to three years high school: Difference = .123 ± .046.

All differences by housing for each educational group were less than twice their standard error, with the following exception:

Women who had attended high school—less than two persons per room higher than two or more persons per room: Difference = .153 ± .051.

Reasons for Rejecting CLB	All Women	Nonrelief Wives of		Wives of Relief Recipients
		White-Collar Workers	Manual Workers	
	Number of women rejecting CLB because of dissatisfaction			
	683	87	406	190
	Per cent rejecting CLB for each reason			
All Reasons	100.0	99.9	100.1	99.9
Difficulty of Renewing Supplies	33.5	25.3	34.0	36.3
Difficulty in Placing CLB or Discomfort	26.4	24.1	28.6	22.6
CLB Esthetically Unacceptable	11.4	17.2	9.9	12.1
CLB Too Much Trouble to Use	9.5	14.9	7.9	10.5
Patient Afraid to Use CLB	4.7	4.6	5.7	2.6
Patient Pregnant in Spite of Use	8.6	9.2	8.1	9.5
Other or Unknown Reason	5.9	4.6	5.9	6.3

Table 29. Distribution of reasons given for the rejection of the prescribed contraceptives by women in three social classes.

white-collar workers, 47 per cent of the wives of manual workers, and 56 per cent of the wives of relief recipients who were still in need of contraception at the time of interview.

The patients gave a variety of reasons for discarding the diaphragm and jelly, but most of these fell into a few broad categories. The most frequent complaints of women of all social classes concerned the difficulty of finding the time or money to come to the clinic for new supplies or for check-up visits.[24] More than one-third of all the women who gave up using the clinic prescription did so for these reasons (Table 29).

More than 25 per cent of women who gave up the prescribed contraceptives did so because the diaphragm was uncomfortable to the husband or wife, or was difficult to place. About 20 per cent of the couples who rejected the diaphragm and jelly found them estheti-

[24] This finding is not a new one. The Committee on Maternal Health has been aware of this difficulty and has been meeting the problem by establishing new clinics in districts more readily accessible to those women who are least able to spend time and money on transportation.

cally unacceptable or too much trouble to use, and an additional 5 per cent were afraid to use them.

The distributions of reasons given by women of the three social classes were much the same. A relatively small proportion of women in the white-collar group found it difficult to return to the clinic but the proportion of women discarding the diaphragm and jelly because they were esthetically unacceptable or too much trouble to use was higher in this group than in either of the other groups.

Only about 9 per cent of the patients who found the diaphragm and jelly an unsatisfactory method of contraception gave accidental pregnancy with the method as their reason for discarding it. Less than a third of the 220 patients who had accidental pregnancies while using the clinic prescription stopped using the diaphragm and jelly because of its failure to protect them against pregnancy. Seventy per cent of those who had accidental pregnancies returned to the use of the diaphragm and jelly after the termination of the accidental pregnancies.

Certain factors appear to be of especial importance in the clinic's loss of patients:

1. The rate of rejection of the diaphragm and jelly was highest in the first four months following the initial clinic visit.

2. The women who found the diaphragm and jelly least acceptable were those who lived in crowded homes, most of them on relief, or with very low incomes. Among women who lived in less crowded homes those with little education used the prescribed contraceptives for considerably shorter periods than women who had had at least some high school education. For women living in the more crowded homes the association between acceptability and education was slight.

3. Thirty-four per cent of the women who rejected the diaphragm and jelly did so because of the difficulty of coming to the clinic for new supplies. An additional 26 per cent found the diaphragm un-

comfortable or difficult to place, and about 20 per cent more found it esthetically unacceptable or too much trouble to use. Comparatively few women discarded the diaphragm and jelly because they became pregnant while using these methods.

THE CLINIC PRESCRIPTION AND ACCIDENTAL PREGNANCY

To serve its purpose in preventing pregnancy, a contraceptive must be effective as well as acceptable. The diaphragm with jelly is a highly effective contraceptive,[18] but not every woman who used it was completely protected against pregnancy. If certain types of women are more likely than others to have accidental pregnancies, special care in training such patients at the clinic may make them more successful in the use of the prescribed contraceptives. Because such a large proportion of patients rejected the diaphragm and jelly and used other types of contraception, it is also important to the clinic to know what types of women had accidental pregnancies with contraceptives other than those prescribed. For the woman whose health contraindicates further pregnancy, even one accidental pregnancy may have disastrous consequences, and should be avoided whenever possible.

As a group, the women who had accidental pregnancies postclinic, either with the prescribed contraceptives or with other types of contraception, were more fertile in the preclinic period than those whose postclinic use of contraception was completely successful. Their pregnancy rates without contraception were higher than those of the women who had no accidental pregnancies after they attended the clinic, but the most important difference in the preclinic rates of the two groups was observed in their rates when contraception was used. The preclinic pregnancy rates with contraception of the women who had accidental pregnancies after attending the clinic were more than half again as high as those of the women whose postclinic practice of contraception was completely successful (Table 30 and Figure 11). Women whose preclinic fertility was

[18] See Table 22.

Period of Married Life	No Contraception Used		Contraception Used	
	All Women Who Had Accidental Pregnancies Post Clinic	All Women Who Had No Accidental Pregnancies Post Clinic	All Women Who Had Accidental Pregnancies Post Clinic	All Women Who Had No Accidental Pregnancies Post Clinic
	PREGNANCIES PER 100 YEARS' EXPOSURE BEFORE CLINIC ATTENDANCE			
First Pregnancies	210	153	135	60
All Later Pregnancies	99	90	78	48
Years Since Marriage				
0–4	102	97	86	55
5–9	101	91	72	46
10–14	85	72	73	43
15–29	79	55	81	41

	NUMBER OF YEARS OF EXPOSURE AND NUMBER OF PREGNANCIES							
	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.
First Pregnancies	163.2	342	501.7	768	53.4	72	300.1	181
All Later Pregnancies	580.7	576	1,051.7	942	1,465.3	1,136	4,646.0	2,217
Years Since Marriage								
0–4	367.9	377	597.1	581	502.7	431	1,522.4	830
5–9	120.2	122	251.2	228	568.5	408	1,756.3	808
10–14	62.2	53	118.7	86	288.7	211	937.7	402
15–29	30.5	24	84.7	47	105.5	85	429.5	177

[1] The total number of women who had accidental pregnancies post clinic was 484. Sixteen women had no exposure or had only exposure without contraception, after clinic attendance, and 1,121 used contraception with complete success after they attended the clinic.

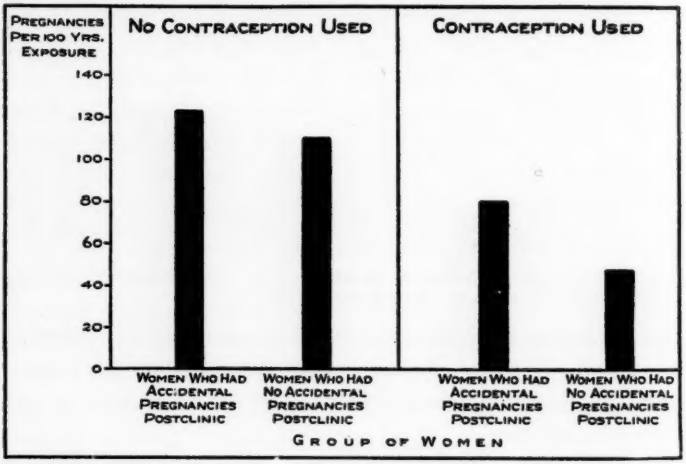
Table 30. Preclinic pregnancy rates of women who had accidental pregnancies after attending the clinic, and of those who had none.[1]

high and especially those whose previous use of contraception was relatively ineffective proved poorer risks from the clinic's point of view than those whose early efforts with contraception had produced better results.

Women who lived in crowded dwellings had higher accidental pregnancy rates with diaphragm and jelly than those who had some privacy (Table 31 and Figure 12). Crowding in the home may have resulted from previously high fertility, but when postclinic pregnancy rates of women with small, medium sized, and large families,

living in homes in which there were two or more persons per room were compared with those of women with families of similar size, who lived in less crowded homes, it was found that both crowding and previously high fertility were associated with high pregnancy rates after attendance at the clinic. Women whose fertility, as expressed by their total number of pregnancies, was high had high accidental pregnancy rates postclinic (another way of showing the relationships brought out by Table 30), and among women with each number of pregnancies, those living in crowded homes had higher accidental pregnancy rates than women whose homes afforded some privacy.[18] These differences were observed both with the clinic prescription and with other types of contraception, after

Fig. 11. Total preclinic pregnancy rates,[1] with and without contraception, of women who had accidental pregnancies after attending the clinic and of those who had none.



[1] Standardization of these rates did not change the rate-relationships.

[18] When pregnancy rates with the prescribed contraceptives were computed for women who lived in homes in which there were two or more persons per room, and those in homes in which there were less than two persons per room, by education of the wife, it was found that there were no significant differences in the rates of the women in over-crowded homes by education, but that in the less crowded homes, there was an inverse association between pregnancy rates and amount of education.

Women with Each Number of Pregnancies	Housing and Type of Contraception			
	CIB		All Other Contraception	
	Two or More Persons per Room	Less Than Two Persons per Room	Two or More Persons per Room	Less Than Two Persons per Room
	Total pregnancies per 100 years' exposure			
All Women	18	5	42	21
Women with 2 or Less Pregnancies	8	1	17	6
Women with 3-5 Pregnancies	19	5	31	25
Women with 6 or More Pregnancies	21	13	52	31

	Number of years of exposure and number of pregnancies							
	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.
All Women	817.2	150	2,001.9	98	570.9	238	932.3	200
Women with 2 or Less Pregnancies	101.2	8	772.7	9	35.8	6	262.4	15
Women with 3-5 Pregnancies	334.2	63	827.2	38	220.5	69	393.7	100
Women with 6 or More Pregnancies	381.8	79	402.0	51	314.6	163	276.2	85

Table 31. Post clinic pregnancy rates by housing and total fertility.

clinic attendance, but in almost every instance the pregnancy rates with the other types of contraception were at least twice as high as those with the contraceptives prescribed by the clinic. These high rates represent the use of various types of contraception and it is difficult to determine just what weight each type of contraception bears in the total rates, since the experience was too small to permit of finer classification.

All women who had accidental pregnancies with the contraceptives prescribed at the clinic were questioned in detail in order to

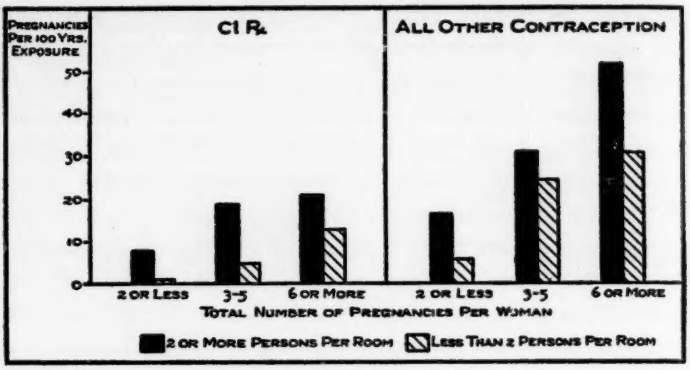


Fig. 12. Postclinic pregnancy rates by housing and total fertility.

ascertain as nearly as possible how these accidental conceptions occurred. Each patient who had had such a pregnancy was asked to explain her technique of use of the diaphragm and jelly, leading questions being scrupulously avoided. In addition, she was urged to state what she thought might have been the cause of the accidental pregnancy. The reasons given were judged in relation to the reported techniques, the clinic record of the difficulty of fitting the patient, and all other pertinent data, and the pregnancies assigned to five broad groups of possible causes. The five categories were:

1. *Error in Technique.* The pregnancy was judged to be due to an error in technique, when the patient's answers to questions concerning her technique of use revealed that she did not know whether the pessary was in place, that she had used insufficient jelly, or that there had been some other deviation from the instructions given her.

2. *Faulty Fit.* Only seventeen pregnancies were grouped in this category. In some cases the patient reported that the diaphragm would not stay in place, or was uncomfortable, while in others the pregnancy occurred shortly after a change in the size of the diaphragm, or the patient's record showed that she was a poor subject for the diaphragm because of seriously relaxed vaginal walls.

3. *Defect in Diaphragm.* The pregnancies grouped under this heading were those of patients who reported that the diaphragm had a hole in it at the time the pregnancy occurred.

4. *Omission.* A large proportion of the patients who had accidental pregnancies reported that the diaphragm had been carelessly omitted once or twice, shortly before conception occurred. In the strictest sense, such conceptions did not take place when the prescribed contraceptives were used. There are three cogent reasons for charging them against the prescribed contraceptives, however: (a) we are concerned with the effectiveness of the method prescribed as used in a population group, and not in its effectiveness under ideal conditions; (b) it is doubtful whether any large group of couples uses contraception with complete consistency, and there is no way of accounting for those occasional lapses which do not result in pregnancy; and (c) there is no certainty that conception took place on the single occasion on which the contraceptive in question was omitted, though, for the present analysis, omission seems the most logical reason to which to ascribe it.

5. *Other or Unknown Reason.* Pregnancies included in this category were mainly those for which the patient could find no reason.

Table 32. Distribution of apparent reasons for accidental pregnancies occurring during the use of clinically prescribed contraceptives, for three social classes.

Apparent Reason for Pregnancy	All Women	Nonrelief Wives of		Wives of Relief Recipients
		White-Collar Workers	Manual Workers	
	Total number of pregnancies			
	248	27	135	86
	Per cent attributed to each cause			
Total	100.1	99.9	100.1	100.0
Error in Technique	34.3	33.3	31.9	38.4
Faulty Fit	6.9	7.4	7.4	5.8
Omission	37.5	29.6	39.3	37.2
Defect in Diaphragm[1]	7.7	7.4	7.4	8.1
Other or Unknown	13.7	22.2	14.1	10.5

[1] Diaphragm torn or badly worn.

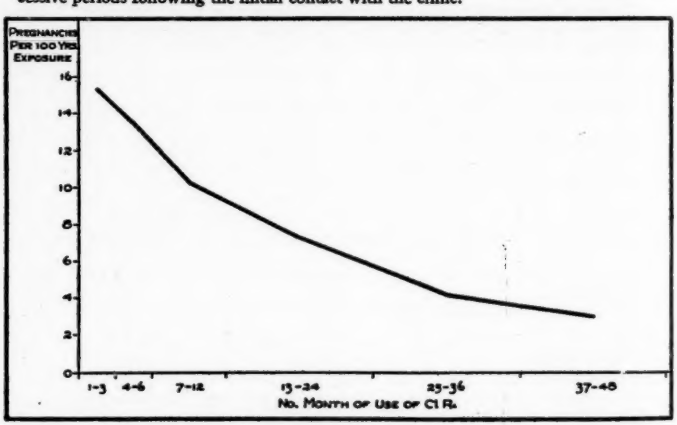
Period Following Initial Clinic Contact	Pregnancies per 100 Years' Exposure	Number of Years of Exposure	Number of Pregnancies
1– 3 Months	15.4	350.8	54
4– 6 Months	13.6	316.6	43
7–12 Months	10.3	365.7	58
13–24 Months	7.3	838.0	61
25–36 Months	4.1	462.0	19
37–48 Months	3.0	200.2	6

Table 33. Total pregnancy rates with clinically prescribed contraceptives in successive periods following the initial contact with the clinic.

In almost every case she reported a perfect technique of use, denied omission on any occasion, and stated that she had found no flaw in the diaphragm.

The distribution of pregnancies attributed to each of these causes is shown in Table 32. About one-third of the pregnancies were ascribed to error in technique and a slightly larger proportion to careless omission of the contraceptive. The distributions did not differ widely for the three social class groups except for the relatively low proportion of omissions reported by the wives of white-collar workers. In this group the number of pregnancies occurring when the diaphragm was omitted may have been higher than re-

Fig. 13. Total pregnancy rates with clinically prescribed contraceptives in successive periods following the initial contact with the clinic.



ported, since the proportion of those for which the apparent cause was unknown was much larger than in either of the other groups.

The increased risk of accidental pregnancy when the prescribed contraceptives were new and unfamiliar is reflected in Table 33 and Figure 13, which show the number of accidental pregnancies per 100 years of exposure to risk among patients using the prescribed contraceptives, in successive periods following the initial contact with the clinic. The highest rates occurred in the first three months after the initial visit to the clinic. After the fourth month of use, the rates dropped, and after a year of use they were less than half as high as those observed in the first three months. After two years the rates were below five pregnancies per 100 years of exposure, and it is reasonable to assume that rates much lower than this could scarcely be expected for any large group. The same trend was observed in the rates of all three social classes (Table 34 and Figure 14), but the rates for relief recipients were consistently and significantly higher than those of self-supporting workers, in each period, and it is probable that they would continuously remain somewhat

Table 34. Pregnancy rates of each social classs with clinically prescribed contraceptives in successive periods following the initial contact with the clinic.

Period Following Initial Clinic Contact	Couples Not on Relief				Couples on Relief	
	White-Collar Workers		Manual Workers			
	Pregnancies per 100 years' exposure					
1–6 Months	9.6		14.4		18.4	
7–12 Months	4.9		10.1		15.2	
13–24 Months	4.4		5.4		15.2	
25–48 Months	2.4		2.7		8.8	
	Number of years of exposure and number of pregnancies					
	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.	Exp. Yrs.	No. Preg.
1–6 Months	114.8	11	395.2	57	157.3	29
7–12 Months	102.5	5	337.9	34	125.3	19
13–24 Months	158.2	7	501.7	27	178.1	27
25–48 Months	122.5	3	414.9	11	124.8	11

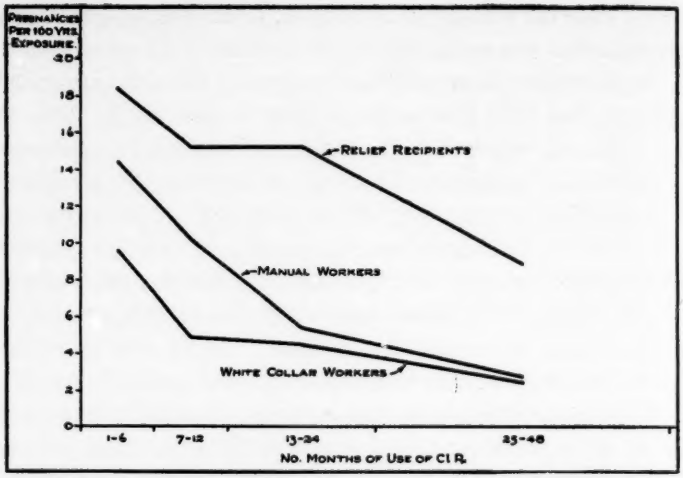


Fig. 14. Pregnancy rates of each social class with the clinically prescribed contraceptives in successive periods following the initial contact with the clinic.

higher than those of either of the self-supporting groups.[37]

The decline in rates with increasing length of use of the prescribed contraceptives was apparent for pregnancies attributed to all causes except defects in the diaphragm (Table 35 and Figure 15). For pregnancies associated with worn diaphragm, the rates showed a slight rise over the period of observation, doubtless because a diaphragm becomes worn only after a lapse of time. As has been shown in Table 32, omission and error in technique were responsible for the largest proportion of the accidental pregnancies. Rates for pregnancies due to error in technique declined with increasing length of use of the diaphragm and jelly. The number of accidental pregnancies per 100 person years of exposure to risk, due to omission, also declined, but the proportion of pregnancies due to omission increased from about one-third of the pregnancies occurring in the first three months following clinic contact to nearly one-half of

[37] The significance of differences between the rates compared in the text was tested in each instance by means of the χ^2 test. See also Part II, footnote 13.

Period Following Initial Clinic Contact	Apparent Reason for Pregnancy					
	Total	Error in Technique	Faulty Fit	Defect in Diaphragm[1]	Omission	Other or Unknown
	Pregnancies per 100 years' exposure					
1–6 Months	14.5	5.2	1.5	0.3	5.1	2.4
7–12 Months	10.3	3.4	0.9	0.5	3.9	1.6
13–24 Months	7.3	2.6	0.1	1.0	3.1	0.5
25–36 Months	4.1	1.1	0.0	0.6	1.9	0.4
37–48 Months	3.0	0.5	0.5	1.0	0.0	1.0
	Exp. Yrs.	Number of pregnancies attributed to each cause				
		Total				
1–6 Months	667.4	97	35	10	2	34	16
7–12 Months	565.7	58	19	5	3	22	9
13–24 Months	838.0	61	22	1	8	26	4
25–36 Months	462.0	19	5	0	3	9	2
37–48 Months	200.2	6	1	1	2	0	2

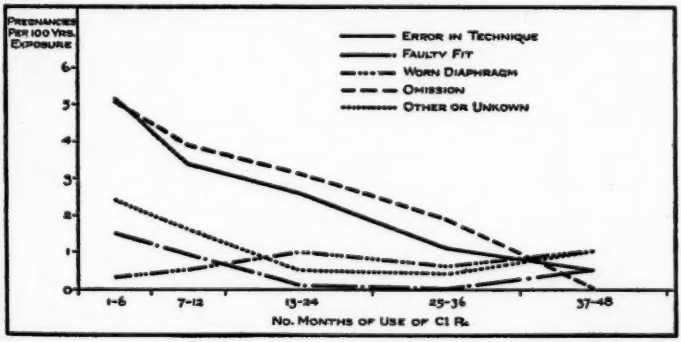
[1] Diaphragm torn or badly worn.

Table 35. Pregnancy rates with clinically prescribed contraceptives in successive periods following the initial contact with the clinic, by apparent reason for pregnancy.

those occurring in the third year of use of the prescribed contraceptives.

Pregnancy rates, with diaphragm and jelly, of women who had anatomical abnormalities which might have been expected to in-

Fig. 15. Pregnancy rates with clinically prescribed contraceptives in successive periods following the initial contact with the clinic, by apparent reason for pregnancy.



terfere with the fit or placing of a diaphragm, remained significantly higher throughout the postclinic period than those of women who had no anatomical abnormalities (Table 36 and Figure 16). The highest rates were observed among women who had fecal impaction when they were examined at the clinic. The variable distortion of vaginal walls in the chronically constipated woman makes the accurate fitting of a diaphragm especially difficult. It is probable that the pregnancy rates of this group of women were more than twice as high as those of women without anatomical

Table 36. Pregnancy rates with clinically prescribed contraceptives of women with and without anatomical abnormalities which might interfere with the fit or placing of a diaphragm, in successive periods following the initial clinic contact.

Period Following Initial Clinic Contact	Women with No Anatomical Abnormalities[1]	Women with Each Type of Anatomical Abnormality				
		Total	More Than One Pelvic Factor	Cystocele and/or Rectocele	Fecal Impaction	Obesity, Short Fingers, etc. ± Pelvic Abnormality
	Pregnancies per 100 years' exposure					
1-6 Months	13	17	12	19	30	21
7-12 Months	9	14	11	12	41	0
13-24 Months	6	10	9	6	19	21
25-36 Months	3	6	3	8	6	—[4]
37-48 Months	2	4	10	0	—[4]	—[4]
Total[2]	8	11	9	10	22	15
	Number of years of exposure and number of pregnancies					
	Exp. Yrs. / No. Preg.	Exp. Yrs. / No. Preg.	Exp. Yrs. / No. Preg.	Exp. Yrs. / No. Preg.	Exp. Yrs. / No. Preg.	Exp. Yrs. / No. Preg.
1-6 Months	464.4 / 62	202.2 / 35	76.0 / 9	91.7 / 17	20.2 / 6	14.4 / 3
7-12 Months	395.5 / 35	169.7 / 23	64.2 / 7	76.7 / 9	17.2 / 7	11.5 / 0
13-24 Months	586.1 / 37	250.9 / 24	98.5 / 9	111.6 / 7	26.7 / 5	14.1 / 3
25-36 Months	316.9 / 10	144.9 / 9	60.5 / 2	62.3 / 5	16.5 / 1	5.6 / 1
37-48 Months	129.2 / 3	71.0 / 3	31.0 / 3	34.8 / 0	4.3 / 0	0.8 / 0
Total[2]	1,941.8 / 151	879.0 / 97	348.3 / 31	399.0 / 40	85.2 / 19	46.4 / 7

[1] This category includes women with malposition of uterus. The pregnancy rates of this group were lower, but not significantly lower than those of women without anatomical abnormalities.
[2] Includes exposure and pregnancies of women who had more than 48 months of exposure.
[4] Less than 10 years of exposure.

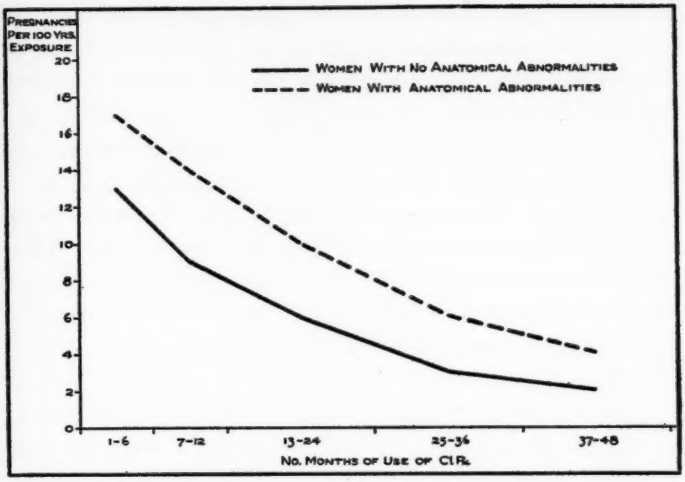


Fig. 16. Pregnancy rates with clinically prescribed contraceptives of women with and without anatomical abnormalities which might interfere with the fit or placing of a diaphragm, in successive periods following the initial clinic contact.

abnormalities, because of the impossibility of the patient's knowing when the diaphragm would fit properly. Another small group with relatively high pregnancy rates included the women who, because of obesity or short fingers or arms, could not know whether the diaphragm was in place. Women with cystocele or rectocele, or both, had pregnancy rates that were slightly higher than those of women whose records showed no anatomical abnormalities. The differences in rates might have been more significant had the experience been greater. The presence or absence of malposition of the uterus or other pelvic difficulties appeared to have no effect on the pregnancy rates.

It is probable that many of the women with cystocele or rectocele were those who had had high pregnancy rates before they attended the clinic, and that the pelvic abnormalities which resulted from frequent childbearing increased the risk of pregnancy with an intravaginal contraceptive device. These women, as well as the

women with fecal impaction were to a great extent those who could not afford the time or money for adequate medical care. The incidence of both types of pathology was much higher among women who lived in crowded homes than among women who lived in homes in which there were less than two persons per room.[18] The various factors which made the use of a complex contraceptive technique most difficult were not isolated, but definitely interrelated. A further finding shows this to be strikingly true. Of the women who lived in homes in which there were two or more persons per room, and who had either vaginal relaxation or fecal impaction, 32 per cent had accidental pregnancies while using the diaphragm and jelly. Only 11 per cent of the women with similar physical disabilities, who lived in homes in which there were less than two persons per room, had accidental pregnancies while using the prescribed contraceptives.

The patients who have large families and low incomes present the greatest difficulties to the clinic. They are the very people who are most in need of effective contraception and at the same time the ones least likely to use a complex contraceptive diligently for any length of time. The social conditions under which they live and the pelvic abnormalities resulting from their previous high fertility make it more difficult for them than for more fortunately situated women to use a diaphragm and jelly. Their problems require a new approach on the part of the clinic.

SUGGESTIONS FOR A REORIENTATION OF CLINIC POLICY

The results of the present study confirm the impression that the diaphragm with spermicidal jelly is a highly effective contraceptive. Contrary to the usual opinion, however, condom is at least as effective as the diaphragm and jelly combination, even when the types of condom used vary widely in quality and when no spermicidal

[18] In the group with two or more persons per room, 22.3 per cent of the women had cystocele, rectocele, or fecal impaction, as compared with 13.9 per cent in the group who lived in homes in which there were less than two persons per room.

substance is used in conjunction with the condom.[19] Other techniques of contraception appear to be less effective than either condom or diaphragm, but their effectiveness as shown for this group, as well as for other groups[20] suggests that with good instruction in anatomy and techniques of use, even the least effective contraceptives may be highly effective for couples who will use them consistently and with care.

The diaphragm and jelly were acceptable to a fairly large group of clinic patients, but since a year after their first visit to the clinic, between one-third and one-half of the patients advised rejected them in favor of some other contraceptive technique, it becomes clear that no single contraceptive is likely to be acceptable to all members of a heterogeneous group of couples. The diaphragm and jelly were given up mainly because the technique was complicated, the diaphragm or jelly was esthetically unacceptable, or because it was difficult to renew supplies. Most of the women who came to the clinic did so because they or their husbands were dissatisfied with the contraceptive methods previously used; yet those couples for whom the diaphragm and jelly proved unacceptable turned to the types of contraception previously used by the group.

A rough estimate of the attitudes of the group toward four types of contraception is given in Table 37. The figures are probably far from accurate, but when judged in relation to the detailed study of the acceptability of the diaphragm and jelly, they point to the wisdom of recognizing individual needs in prescribing a contraceptive.

Among the four contraceptives listed there was none that was disliked by all couples, nor was there any that was liked by all. Those most popular with both men and women were the diaphragm and jelly, and the douche. The latter was slightly more

[19] Table 22.

[20] Stix, Regine K. and Notestein, Frank W.: Effectiveness of Birth Control. The Milbank Memorial Fund *Quarterly*, April, 1935, xiii, No. 2, pp. 162-178; and unpublished material on the postclinic pregnancy rates of the same group of New York women.

Attitude Toward each Contraceptive	Diaphragm and Jelly		Condom		Coitus Interruptus		Douche	
	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband
	Number of individuals reporting attitudes							
	1,572	1,565	782	800	786	845	320	26
	Per cent of those reporting							
Liked Contraceptive or was Indifferent to it	80.2	87.5	54.5	11.4	61.5	12.3	84.7	84.6
Disliked Contraceptive	19.8	12.5	45.5	88.6	38.5	87.7	15.3	15.4

Table 37. Attitudes of husbands and wives to four types of contraception.

acceptable to the women than the diaphragm, probably because of its simplicity. The male methods of contraception, condom and coitus interruptus, were more acceptable to the wives than to the husbands in the group, though less acceptable to both than either of the other contraceptives. The assumption that all couples who apply to a birth control clinic for advice dislike the techniques of contraception previously used is apparently unwarranted.

It would seem wise to prescribe diaphragm and jelly for those patients for whom they are suitable, who are willing to take the trouble to use them, and who have the requisite intelligence, privacy, and time to undertake the complicated procedures required. Even these selected patients should be encouraged to return to the clinic for a different type of contraception if the diaphragm should prove unacceptable. The patient who is chronically constipated, or who is difficult to fit for other reasons, should be given contraceptives to be used by the husband whenever possible. For those couples who have previously found other contraceptives satisfactory, the best methods of using those contraceptives should be taught. New and simple techniques are being developed which may prove satisfactory for people with limited intelligence, who live in crowded quarters. It is probable that such groups can never be taught to use

contraception as effectively as less handicapped people who have fewer economic and social difficulties with which to contend.

The increased hazard of accidental pregnancy when techniques are new points to the need of additional warning concerning special care in the use of the diaphragm for the first few months. More intensive training of patients for whom contraception has previously been ineffective may also help to reduce the risk of accidental pregnancy.

The establishment of readily accessible clinics in congested areas appears to have aided in reducing the loss of clinic patients in Cincinnati. It is possible that a more flexible system for renewal of supplies might reduce still further the proportion of patients who fail to return because they cannot spare the time or money for a trip to the clinic. A simple system of mail service for supplies, together with the substitution of an annual for a semi-annual check-up visit might reduce the amount of transportation necessary for the patients. On the other hand, extra time and service might profitably be given each patient on the initial visit to the clinic, and on as many immediately subsequent visits as may be necessary to supply her or her husband with a satisfactory and acceptable contraceptive that will be used consistently. Some couples may prefer to alternate the use of several contraceptives rather than to have one partner assume sole responsibility for the prevention of conception. Such a preference is only natural and human and should be recognized by the clinic. The necessary changes in policy may best be characterized as changes tending toward the recognition of human differences and preferences—with a new orientation toward suiting the individual patient rather than expecting all patients to accept a single method of contraception.

The institution of new policies should be undertaken slowly and with recurrent evaluation of their effect. Comparison of the effect of a new policy on the proportion of patients active before and after its inception is a rough but useful measure which may be made at

any time. Patients who fail to return to the clinic should be followed up in order to ascertain the reasons for their dissatisfaction with the clinic's services. Many of them would welcome the opportunity to obtain other types of contraception at minimum cost and to learn the best methods of use of those contraceptives.

The maternal health clinic must strive to provide each patient with the contraceptive which will prevent the hazard of pregnancy for her. The most effective contraceptive is of no use in the hands of the patient to whom it is not acceptable, while the contraceptive usually thought to be ineffective may offer a real protection against pregnancy to the patient who will use it consistently and in accordance with the best available instructions.

SUMMARY

In the years 1930-1934, occlusive diaphragms with spermicidal jelly were prescribed for 98 per cent of the patients of the Cincinnati Maternal Health clinics. When these patients were followed up, in a study conducted by the Milbank Memorial Fund, it was found that a substantial proportion of them had rejected the prescribed contraceptives. The loss of these patients suggests that changes in clinic policy may be advisable.

The most rapid loss of clinic patients occurred within four months of their first contact with the clinic. A year after the initial clinic contact, between 52 and 71 per cent of those patients who were still in need of contraception were using the prescribed contraceptives.

The dominant factor associated with the acceptability of the contraceptives prescribed by the clinic was the degree of crowding in the home. Women who lived in homes in which there were two or more persons per room found the diaphragm and jelly less acceptable than those who lived in homes in which there were less than two persons per room. There were also differences in length of use by education and social class.

One-third of the women who rejected the diaphragm and jelly

gave as their reason the difficulty of returning to the clinic for new supplies. Nearly half of those who gave up the prescribed contraceptives did so because the diaphragm was uncomfortable, difficult to place, esthetically unacceptable, or too much trouble to use. Only 9 per cent of the women who discarded the clinic prescription did so because of its failure to protect them against pregnancy.

It was found that the effectiveness of the diaphragm and jelly differed under different conditions and for different groups of women. The groups for whom the diaphragm and jelly were least effective were (1) women whose preclinic fertility was high and whose preclinic use of contraception was ineffective, (2) women who lived in homes in which there were two or more persons per room, and (3) women with anatomical abnormalities interfering with the fit or placing of a diaphragm.

Pregnancy rates with the prescribed contraceptives were highest in the three-month period following each patient's first contact with the clinic. They declined steadily until, after two years of use of the diaphragm and jelly, there were less than five pregnancies for each 100 person-years' exposure to pregnancy.

In view of the findings noted, it is suggested that clinic policies be changed to permit the more flexible prescription of a variety of contraceptives, suiting each to the individual patient. The type of contraception should be changed, if the patient is dissatisfied with the method first prescribed.

The clinic is urged to give more intensive training at the initial clinic visit and to make it possible for the satisfied patient to return only once annually, meanwhile securing supplies by mail.

The clinic must aim to provide each patient with a contraceptive that is acceptable to her and will prevent the hazard of pregnancy for her. A contraceptive that is usually thought to be relatively ineffective may prove highly effective for the patient who likes it and will use it diligently.

INDEX

TO TITLES OF ARTICLES AND AUTHORS

IN THE MILBANK MEMORIAL FUND QUARTERLY

VOLUME XVII · 1939